THE HOLOCENE PREHISTORIC ARCHAEOLOGY OF THE TEMBEN REGION, NORTHERN ETHIOPIA

By

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Evidence from agronomy and bio-geography shows that northern Ethiopia is a center of origin of several economically important African plant domesticates that played a major role in the emergence of Neolithic societies. Although archaeologists have speculated on how and why these food producing societies have emerged, in the past, there was virtually no archaeological data with which to test the hypotheses they have developed.

Recent systematic archaeological surveys and excavation in the Temben area of northern Ethiopia have identified sites that have provided radiometrically datable stratified cultural sequences containing preserved faunal remains, a

necessary temporal sequence that would allow us to begin testing the various hypotheses.

The analysis of the cultural materials and ecofacts recovered from these sites would lay the groundwork for future archaeological investigations in northern Ethiopia by furnishing significant necessary data towards the understanding of the Neolithic of northern Ethiopia, an area that is situated in the bio-geographical heart of the hypothesized center of Ethiopian plant domestication.

CHAPTER 1
INTRODUCTION

According to agronomists and bio-geographers, Ethiopia is one of the world's few primary centers of prehistoric domestication of food crops (Harlan 1969, 1975, 1982, 1993, 1995, 1997; Sauer 1952; Vavilov 1951). Ethiopian domesticates include: teff (Eragrostis tef), noog (Guizotia abyssinica), finger millet (Eleucine coracana), enset (Ensete ventricosum), chat (Catha edulis), coffee (Coffea arabica), and a wide range of other legumes and root crops. These indigenous crops play a critical role in contemporary Ethiopia's four major agricultural systems: 1) the plow and cereal complex of the central and northern highlands; 2) the mixed-farming complex of the western lowlands; 3) the hoe and cereal complex of the southeastern highlands; and 4) the hoe-vegeculture complex of the southern highlands (Westphal 1974, 1975). The pastoral complex of the arid and semi-arid zones that almost encircle the country is yet another system that is dependent on the production of livestock (Amare 1978, 1980).

Unfortunately, unlike other regions of the world recognized to be important centers of domestication (e.g., the Near East and Mesoamerica), there has been surprisingly little archaeological research into the evolution of Ethiopian food producing systems. Only **six** prehistoric sites in all of Ethiopia have provided evidence, albeit meager, for domesticated plant and animal remains (Barnett 1999a, 1999b; Brandt 1980, 1982, 1984; Clark 1988; Dombrowski 1970; Phillipson 1993), and it is only at one locality (Lake Beseka in south-central Ethiopia) that a relatively securely dated cultural sequence for the Holocene has been established (Brandt 1980, 1982; Clark and Williams 1978). Consequently, the archaeological data necessary to test the various theories proposed to explain the processes of domestication and the evolution of Ethiopia's food producing systems are virtually non-existent.

Therefore, the objective of this dissertation is to undertake the first stage of what is projected to be a long-term study on the evolution of agricultural societies in the northern Ethiopian highlands. This modest first stage involves the establishment of northern Ethiopia's Neolithic sequence through the analyses of recently excavated sites in the Temben region of Tigray, northern

Ethiopia, and a preliminary inference of the nature of social and subsistence systems of the region during the Holocene.

Theoretical Perspectives on the Origin and Development of Prehistoric Agriculture in Northern Ethiopia

Models for the evolution of prehistoric agriculture in Ethiopia in general and northern Ethiopia in particular can generally be divided into two groups: those that focus essentially upon the migration of peoples from outside Ethiopia and/or the diffusion of foreign domesticates and their products as the main stimuli for food production; and those that argue for autochthonous domestication of local wild plant foods by indigenous hunter/gatherer populations, followed by the introduction of foreign populations and/or domesticates (Brandt 1984; Brandt and Fattovich 1990; Phillipson 1993).

Migration/Diffusion Models

As early as 1930 C. R. Seligman (1930) suggested that "Hamitic" peoples migrating from the Near East were responsible for introducing wheat, barley, the plow and an agricultural way of life to the highlands of Ethiopia and Eritrea. Other scholars such as Doggett (1970) and Purseglove (1976: 293) also accepted migration explanations

by arguing that "Caucasoid" agriculturalists moved into northeast Africa from the Near East or the Arabian Peninsula 5,000 or more years ago, bringing with them their agricultural techniques as well as domesticated wheat and barley. By the fourth or third millennium BC, these scholars maintained, Ethiopian descendants of the "Caucasoid" migrants subsequently domesticated sorghum and other local plants.

Rather than immigrants from the Near East, G. P. Murdock (1959) hypothesized that Eastern Sudanic speaking "Pre-Nilotes" were the people responsible for bringing "Sudanic" agricultural practices (i.e., a sedentary lifestyle, animal husbandry, and the cultivation of sorghum, cotton, sesame, and other crops by use of the hoe and digging stick) to the indigenous "Bushmanoid" and "Caucasoid Cushite" hunter-gatherers of the lowlands and bordering hills of western Ethiopia sometime before 5000 years ago. Although the "Bushmanoids" were soon displaced or became totally acculturated by these "Pre-Nilotes," the Cushitic peoples expanded their newly acquired agricultural economy by domesticating locally available plants and improving upon others.

Murdock (1959) and others (e.g., Simoons 1960, 1965) suggest that Central Cushitic speaking peoples such as the

Agew were the first Ethiopians to use the plow and to cultivate crops, developing a farming system based on livestock and the cultivation of such indigenous cereals as teff and finger millet. Cattle, sheep, and goats, as well as the plow, wheat and barley, were obtained from ancient Egypt. Alternatively, Murdock contended, wheat and barley were brought into Ethiopia by Semitic speaking southern Arabians during the first millennium BC. These Semitic immigrants incorporated Ethiopian farming practices with their own methods of agricultural intensification, thereby laying the economic foundation for the Aksumite kingdom, a state that flourished from 100 BC to around 1000 AD.

Taking a somewhat different perspective, J. D. Clark (1954, 1976) has argued that the mid-Holocene aridity of the Sahara forced "C-Group" pastoralists to migrate to Sudanese Nubia, and in search of new pastures they continued their migration into the northern Ethiopian highlands. These populations were responsible for introducing a pastoral way of life, cattle, and ovicaprids to the indigenous hunting and gathering populations of the Horn. Clark (1980) further maintained that by the late third and early second millennium BC, Murdock's "pre-Nilotes" migrated from the lowlands of eastern Sudan on to the highlands of northern Ethiopia and introduced farming

to the indigenous hunting/gathering peoples, who then on their own cultivated indigenous plants such as teff, noog and perhaps finger millet. Wheat, barley, and other cultigens of the "Near Eastern complex" were not grown in Ethiopia until these crops and the plow were first brought into the region by Semitic-speaking southern Arabians who settled in the northeastern part of the country sometime around 500 BC (and soon thereafter formed the basis of the Aksumite kingdom). Otherwise, Clark (1976) reasoned, indigenous Ethiopian cereals would never have been domesticated if wheat and barley had a long history of cultivation in Ethiopia. Drawing upon contemporary pastoral movements of the region, Clark (1988) also hypothesized that forms of transhumance would have developed early as the lowland-based pastoralists moved their herds into the highlands, while the farmers took their herds to the lowlands of western Ethiopia/eastern Sudan.

Autochthonous Models

Representing a radical departure from previous models, C. Ehret (1976, 1979) proposed that the origins of Ethiopian agriculture owed little to developments outside the Horn, and that agriculture was established much earlier than others have suggested. Drawing essentially upon

historical linguistic information, Ehret argued that a major food crisis at the end of the Pleistocene, brought on by severe drought and demographic pressure, forced "proto-Afroasiatic" speaking peoples occupying the highlands of Ethiopia to intensify their efforts at harvesting wild grasses, eventually leading to domestication. By 7000 BP "proto-Cushites" in the northern and central Ethiopian highlands were cultivating such indigenous cereals as teff and/or finger millet. Following the establishment of agriculture in the highlands, domesticated humpless cattle and ovicaprids diffused into Ethiopia from the north, and were rapidly incorporated into the agricultural systems. By 5000 BP the farmers of highland Ethiopia were introduced to wheat and barley from the Nile Valley, as well as the plow and draft animals. Over the next two thousand years, Northern, Central and Eastern Cushitic speaking cattle pastoralists established themselves in the Afar Rift, Somalia and along the Red Sea.

S. A. Brandt (Brandt 1984, 1996, in prep.; Brandt and Fattovich 1990) has developed a model that, although focused on enset domestication, has relevance to understanding the evolution of Ethiopian food production in general. Brandt argues that during the height of the Last Glacial, ca 18,000-10,000 years ago, the hyper-arid

conditions of Ethiopia and East Africa resulted in major changes in the vertical and horizontal zonation of environments and the abundance and predictability of critical resources (Ambrose 1984; Brook et al. 1997; Gasse et al. 1980; Hamilton 1982; Marean and Gifford-Gonzalez 1991). Under these conditions, Brandt argues, the highlands of Ethiopia became an environmental refuge where "complex," more sedentary hunter/gatherer systems emerged. Such groups would have intensified the use of certain plants and animals as dependable, stress-relieving food resources (Hayden 1982; Henry 1989). Intensive use led to the domestication of such cereals as teff, finger millet and perhaps sorghum and the establishment of extensive forms of agriculture. Sometime during the early to mid-Holocene, cattle, ovicaprids and non-Ethiopian cultigens such as wheat and barley diffused into the Ethiopian highlands from the north and west. Soon thereafter, the introduction of the plow resulted in the development of more intensive systems of food production. Farmers engaged in considerable interaction (Gregg 1988; Spielmann et al. 1990) with the lowland pastoralists of the Red Sea coast and Afar Rift (Brandt and Carder 1987), as well as the pastoral and mixed-farming systems of eastern Sudan and western Ethiopia (Sadr 1991).

Archaeological Evidence

In spite of over half a century of scholarly interest in the origins of Ethiopian agriculture, only six sites in all of Ethiopia provide direct evidence for domesticated animals or plants, of which only two are from northern Ethiopia. From test excavations at Gobedra rock shelter in Tigray, D. Phillipson (1977) recovered uncharred, fresh-looking seeds of finger millet, along with dental fragments provisionally identified as domestic *Bos*, and a single domestic camel tooth, all of which were found in association with a microlithic industry and ceramics. Phillipson (1977) estimated the stratum associated with *Bos* to be ca. 3000 BP, while the lower stratum which included the finger millet and camel tooth was estimated to date to between 7000 and 3000 BP. However, subsequent radiocarbon accelerator dating of the uncharred finger millet seeds to ca. one thousand years ago (Phillipson 1993) indicates the intrusive nature of the recovered grains and brings into question the validity of any of the dates assigned to the cattle or camel remains. However, Fattovich (1990) suggests that the pottery from Gobedra shows affinities with ceramics from surface collections at Agordat in Eritrea (Arkell 1954) and those of the Atbai Ceramic Tradition of eastern Sudan, thereby indicating an age of 4-3,000 BP.

Excavations at Lalibela and Natchebiet caves near Lake Tana in northwestern Ethiopia (Dombrowski 1970, 1971) yielded charred remains of barley, legumes and chickpeas in association with ovicaprids and possible domesticated cattle, pottery, grinding stones, and a microlithic industry dated to no earlier than 2500 BP. However, the cultigens are of the "Near Eastern" complex and therefore only provide minimal age estimates for the use of these domesticates in Ethiopia. However, although chickpeas (Cicer arientinum) are generally considered to be of Near Eastern origin, it is noteworthy that its wild relative (Cicer cuneatum) exists in northern Ethiopia (Engels and Hawks 1991:132).

These are the only three prehistoric sites in all of Ethiopia that have provided direct evidence for domesticated plants. Other evidence for early food production in northern Ethiopia in the form of livestock include cattle and possibly donkey bones identified from deposits excavated in the 1940's by Col. Moysey at Quiha rock shelter near Mekele (reported in Clark 1954:40, 324, 353; 1988; Barnett 1999a, b). The bones were found in association with ceramic-bearing LSA/Neolithic assemblages composed of obsidian microliths, small scrapers, blades and blade cores. While Clark (1988:59) suggests that this

lithic assemblage, particularly the "blades with marginal retouch [are] not unlike those of the East African Elementeitan-Industry," Fattovich (1977:12) refers to them as "traces of Elementeita like industry." On the other hand, Bower (1988:104; Bower 1991:74) sees connections between the pottery from Quiha and those of Narosura ware (one of the several Pastoral Neolithic ceramic types of East Africa) and suggests southward pastoral movements from this part of northern Ethiopia to East Africa. However more data are needed before confirming these propositions.

Clark (1988) argues that the decorated Quiha pottery is similar to those of Agordat (Arkell 1954) and therefore the pottery of the Atbai Tradition of Eastern Sudan (Fattovich et al. 1984). Therefore, Clark (1988) postulates a 4-3000 BP date for the deposits at Quiha (and also Agordat), although obsidian hydration dates put the age of Quiha considerably later.

The recent re-analysis of the Quiha materials (Barnett 1999a,b) did not answer these problems either as a "significant proportion of the total artifact collection was derived from unknown provenience" which made it "unclear whether ... [they] had been obtained from a discrete excavated context, from surface collection at the site itself, or from survey in the surrounding area" (Barnett

1999b:14). Although the author is thus cognizant of the lack of provenience of most of the lithic and ceramic artifacts of Quiha rock shelter, she still analyzes them as "one homogeneous collection, termed 'miscellaneous context'" (Barnett 1999b:14). For instance, 221 lithic artifacts come from the lower two levels and from an unknown context. Of the more than 100 sherds (103 in Barnett 1999a:127; 124 in Barnett 1999b:16) only 44 are from a stratified context. All these, however, are analyzed as if they were all found in situ and far reaching conclusions are presented.

However, all the faunal samples were found in situ and Barnett's (1999a,b) study, besides replicating part of previous results (Clark 1988), offers better details of the faunal assemblage of the site of Quiha. The faunal remains consist of 19 mammalian teeth recovered from the lowest two levels in stratified context. They represent domesticated Bos, an Equus, and one Homo sapiens (Barnett 1999a,b). Although Clark (1988) states that zebu is represented in the Quiha fauna based on vertebral remains, there was no such material when Barnett (1999a,b) reanalyzed the material. As opposed to Clark (1954, 1988) Barnett (1999a,b) maintains that the lowest levels of the Quiha rock shelter date to the 7th-6th millennium BP. If so this

would push back the earliest known evidence of domestic animals in the region. Unfortunately, however, there are no radiocarbon dates with which to corroborate this age.

The only other evidence for early domesticated animals in northern Ethiopia is in the form of rock art. Virtually all the rock art sites are found on the walls of rock shelters in central and eastern Tigray. They are characterized by painted and engraved scenes of domestic animals, especially humped and humpless cattle (Agazi 1997a; Drew 1954; Gigar 1979).

Stylistically, the "pastoral rock art" of northern Ethiopia (Agazi 1997b) is similar to rock art sites throughout the Horn of Africa, and falls within what Cervicek (1979) has termed the "Ethiopian-Arabian" style. Cervicek (1979) also distinguishes two main stages in the development of the "Ethiopian-Arabian" style: the "Surre-Hanakiya" stage and the "Dahthami style proper"--names that were derived from sites in Ethiopia (Surre) and Arabia (Hanakiya and Dahthami). The former contains paintings of humpless cattle and sheep. These were, during the succeeding "Dahthami style proper" stage, replaced by zebu (and later camel) paintings and engravings. Although no direct radiometric dates for these art styles are available, archaeological data, hypothesized migrations of

early pastoralists and the thematic content of the rock art suggest a mid-Holocene (ca.5000-3000 BP) age for the "Surre-Hanakiya" style and a late Holocene age (c.2000 BP) for the "Dahthami style proper" (Brandt and Carder 1987; Cervicek 1979). Brandt and Carder (1987) suggest that the stylistic similarities of the early phase of rock art tradition of the Horn and the stylistic diversity of the succeeding stage represent inter- and intra-regional interaction respectively.

Elsewhere in Ethiopia excavations at Laga Oda rock shelter in eastern Ethiopia and an open air site at Lake Beseka in central Ethiopia have yielded the remains of domestic cattle dating to ca. 3500 B.P. (Brandt 1982; Clark and Prince 1978; Clark and Williams 1978). Although Laga Oda was excavated to 140 cm below surface, cattle remains come from the upper 80 cm. There are no caprines represented at the site and camel occurs only in the topmost levels dating to the last few hundred years. No domestic stock is represented below 80cm. Use wear analysis of the microliths has indicated that these were probably used for grass collection since around 15,000 years ago (Clark and Prince 1978).

Of particular interest from Lake Beseka is the Abadir Phase of the Beseka industry, characterized by microliths

and the first appearance of pottery and grinding stones at the site. Although there are no secure dates for the earliest occurrence of ceramic bearing deposits the age of 7000-6000 BP has been suggested on stratigraphic grounds (Brandt 1982). It is, however, in the succeeding Late Holocene phase dominated by scrapers and dated to 3500 BP that domestic cattle have tentatively been identified.

Archaeological evidence in neighboring Sudan also provides indirect but important information bearing on the Neolithic of northern Ethiopia. Recent fieldwork in eastern Sudan has yielded evidence for the "herding" of cattle and ovicaprids by the 6th-5th millennium BP (Fattovich 1988), followed by the possible addition of sorghum cultivation at Gash Group sites by ca. 5000 to 3500 BP (Fattovich et al. 1984; Sadr 1991; but see Clark and Stemler 1975; Rowley-Conwy 1991). Contact between eastern Sudan and the highlands of Ethiopia is inferred from the ceramics and obsidian artifacts recovered from Kassala Phase sites in Eastern Sudan dating from the middle of the 6th to the end of the 4th millennium BP. The obsidian source(s) of these artifacts has been determined to be the highlands of Ethiopia, suggesting inter-regional interaction (Fattovich et al. 1984). Indeed Fattovich and his co-authors go on to state that "by the 2nd millennium BC there was considerable

contact between the eastern area of the Atbai Tradition and ... Ethiopia" (Fattovich et al. 1984:185).

Objective

As should be obvious from the discussion of the archaeological record presented above, the data necessary to support or refute the hypotheses developed by archaeologists to understand the Neolithic of northern Ethiopia, or for that matter any hypotheses, are woefully inadequate. It is very difficult, if not impossible, to test a series of hypotheses in a region which lacks a well defined chronology, much less to talk about prehistoric subsistence.

However, all the hypotheses depend to one extent or another upon a mix of *in situ* developments, migration and/or diffusion, and inter-regional interaction as major factors in the establishment of prehistoric agriculture in the northern Ethiopian highlands. Therefore, a wide range of critical data are required in order to test them. These include, but are not limited to

1) A securely dated Holocene culture-historic sequence for the northern Ethiopian highlands and neighboring lowlands derived from detailed analyses of lithic and ceramic assemblages tied to radiometrically dated litho-stratigraphic sequences;

2) Regional settlement studies involving detailed functional analysis and description of sites over time and space;

3) Systematic investigations of rock art and its relationship and correlation with the regional archaeological record and paleoecology;

4) Detailed analyses of faunal and floral samples large enough to provide information on the domestication process and changing patterns of diet and subsistence; and

5) Paleoenvironmental data sufficient to allow for the reconstruction and secure dating of Holocene environmental changes, which can then be tied to the cultural record.

To obtain such necessary data requires long term and intensive multidisciplinary archaeological research. Therefore, the main objective of this dissertation is to take the first step toward obtaining such data, by reconstructing the culture chronology of the Temben region of northern Ethiopia (Fig. 1.1) that has yielded sites with artifactual and faunal remains.

A cultural chronology is the essential first step necessary for any hypotheses to be tested. Only then can we begin to ask questions of causes and processes. Even introductory archaeology books recognize the usefulness of culture history by stating that

> culture historical interpretations provide the foundation for deductive inquiry designed to identify specific causes of cultural change and stability....rather than being completely obsolete or invalid, cultural historical interpretations provide necessary framework upon which cultural processual interpretations are made. (Sharer and Ashmore 1979)

Very recent archaeological investigations elsewhere in East Africa have spent time to reconstruct culture chronology. Thus Robertshaw (1990a) had to reconstruct the culture chronology of western Kenya in order to understand the evolution of pastoralism in the region. This was because large areas are archaeological terra incognita, a situation that is common in many parts of Africa (Robertshaw 1990b).

Selection of the Study Area

The Temben area, located at 39°01'50" East and 13°37'30" North, is composed of a series of river valleys that are surrounded by sandstone hills ranging in elevation between 2000-2600 meters. It is drained by the Ghiba, Tanqua, and Chini rivers, which flow to the Tekeze river to become part of the Nile drainage system. This area was selected for excavation for a number of reasons.

First, one of the problematic avenues of the Holocene archaeology of Ethiopia, indeed of the Horn of Africa, has been the lack of data for the origins and development of the Neolithic. To borrow a phrase that has been used elsewhere (Gautier 1987), there is a lamentable lack of data, but a "surfeit of models." Therefore finding, much

less excavating, sites in Temben would be ideal as it is a region that is situated at the heart of the hypothesized domestication of what are known as the Ethiopian cultigens.

Second, the surveys undertaken in Temben yielded many open air and cave sites along the mountains that surround Abiy Adi, with some of them having a potential for stratification. The artifact scatters on the surfaces of these sites indicated that the region was inhabited by LSA/Neolithic peoples.

Furthermore, the Temben area is spatially situated between previously excavated but widely separated sites. To the west, Lalibela and Natchebet were excavated by Dombrowski (1970, 1971). To the east Gobedra was excavated in the mid-1970's (Phillipson 1977). The Temben area, by virtue of its spatial location between these two sites, was expected to provide materials that could be used for intra-site comparison.

Fourth, the discovery of new rock art sites that, under present conventional wisdom, belong to the mid-Holocene in a hitherto archaeologically uninvestigated area of northern Ethiopia made the Temben region an exciting area for further investigation. Full investigation of these rock art sites and, besides description, analyzing them in conjunction with the rest of the rock art of the Horn of

Africa provide a fuller picture of prehistory of the recent past of the region.

Finally, data recovered from these sites could serve as a background to the Neolithic socio-economic base of the development of Aksumite civilization, another aspect of the archaeology of Ethiopia that is not fully understood.

Survey in Temben

In June 1996 I conducted a preliminary archaeological reconnaissance of the Temben region (Fig. 1.2). Since this region had never been explored by archaeologists, the aim of the pilot survey was to document archaeological occurrences, including open air sites, rock shelters and caves that had the potential of providing artifact-bearing stratified deposits for future excavation (Agazi 1997a).

The survey employed the combined use of oral informants and a stratified surface survey using topographic maps and compasses. The survey covered ca. 20 km^2 and yielded a total of 29 caves (ranging in size from 1.5 m long and 1 m deep to 64 m long and 4 m deep), one cave as well as seven open air sites of varying expanse. Later, two more caves were found by Dr. S. Brandt and I during the course of excavation (Table 1.1). SASES coordinates (Nelson 1973) were assigned to these sites.

Many of the sites revealed noticeably dense surface concentrations of flaked stone artifacts, groundstone implements, and potsherds. Some of the sites also contained bone fragments *in situ* together with other artifacts (Table 1.1). The lithic assemblages appeared to be LSA/Neolithic in age, and consisted of microliths, rare scrapers and numerous blades and blade cores that show general similarities with the Quiha (Clark 1954) and Gobedra (Phillipson 1977) assemblages. Raw materials were dominated by chert of different colors, but obsidian, quartz, and agate artifacts were also observed. Quartz outcrops were observed within a 150 m distance from some of the sites (e.g., EjJu35 and EjJu36). A few kilometers north of the town of Abiy Adi on the Temben-Adwa road are also concentrations of quartz boulders. Quartz artifacts appear therefore to be of local origin. Chert and obsidian nodules were also noted on the bed of the Tanqua river that flows near the town of Abiy Adi (Fig. 1.2).

The stone artifacts were sometimes found in direct association with potsherds of different texture, size, inclusion, decoration, and color, the latter of which ranged from light gray to orange, red, and black. The potsherds varied in thickness, temper, slip, and burnish.

A number of these rock shelters also contain rock art (Agazi 1997a; Table 1.1). While many of them reveal petroglyphs with geometric motifs only, several of the sites (e.g., Dabo Zellelew [EjJu 17], Mihdar Abur [EjJu 22], and Tselim Ba'ati [EjJu 36]) clearly display animal and/or human figures that can be placed in the already established, albeit tentatively dated, culture-historic framework for the rock art of the Horn of Africa (Brandt and Carder 1987; Cervicek 1979).

Organization of Dissertation

The basis of this dissertation is the excavation and analysis of the cultural materials and ecofacts recovered from five of the many sites discovered in Temben, as well as the rock art present in some of the caves. Any consideration of Holocene occupation of Temben should be grounded in an understanding of the region's climatic and ecological conditions. Accordingly, Chapter 2 reviews the present and past environments of the region. In this chapter I look briefly at the general geology and physiography of Ethiopia and review the present inhabitants of the region.

The main component of this dissertation is the analysis of the cultural materials and ecofacts recovered

from the Temben excavations. Chapters 3 to 6 dwell upon the analyses of these cultural materials, fauna, and rock art recovered from the Temben sites. Chapters 3 deals with the site of Danei Kawlos while the site of Ba'ati Ataro is the subject of chapter 4. Both Danei Kawlos and Ba'ati Ataro are cave sites that were deeply stratified. Three sites (Dabo Zellelew, Shegalu, and Emba Ahmedin) are treated in Chapter 5 as they proved to be relatively shallow containing fewer materials.

Rock art represents a compelling, albeit not very well utilized, source for the understanding of people of the past. Because it is not found everywhere and perhaps because not many archaeologists exploit the resource, rock art has in many cases been confined to the embellishment of books or magazines. In this dissertation, the new rock art sites of Temben are discussed in Chapter 6, and compared with the evidence from previous rock art studies in the Horn of Africa.

Chapter 7 synthesizes the current results from the Temben sites and provides a cultural chronological framework of three periods recognized on the basis of artifact and rock art analysis discussed from chapter three to six. Based on this analysis some tentative affinities of these periods with other sites within and beyond Ethiopia

are offered. However, because there have been few sites excavated in the region the chronology naturally encompasses a large time span. It is, however, hoped that this chronology will be refined with further archaeological investigation, and thus provide a foundation upon which archaeological hypotheses can be tested.

Table 1.1, Showing some selected sites

LOCAL NAME	SASES	SITE TYPE	SIZE IN METERS (L x W x H)[1]	LITHICS[2]	CERAMICS	ROCK ART[3]
Embahmedin	EjJu1	rock shelter	3 x 2.5 x 4	m; b; gs	a few	none
Mai Da'ero	EjJu5	open air	25 x 78	b; bc	present	
Enka'a Dewel	EjJu8	open air	35 x 11	m; b; bc	a few	
Shegalu	EjJu11	cave	30 x 8 x 4	flakes	none	none
Dabo Zellelew	EjJu17	cave	(?)* x 4.6 x 3	b; bc	present	SH; D; GEO
Danei Tikun	EjJu18	cave	2 x 3 x 1.5	flakes	present	GEO
Mihdar Abur	EjJu22	cave	64 x 4 x (?)*	none	none	SH; GEO
Danei Kawlos	EjJu23	cave	13.5 x 8 x 3.5	flakes	present	?
	Ejju30	rock shelter	1.5 x 1 x 1	flakes	present	GEO
Mai Ila	EjJu31	open air	48 x 20	b; bc	a few	
Tselim Ba.ati	EjJu36	rock shelter	24 x 4 x (?)*	flakes; bc	present	SH; D
Ba'ati Ataro	EjJu37	cave	25 x 12 x (?)*	flakes; bc	present	SH; D

Notes: **1.** L, W, and H refer to length, width, and height respectively.
2. m=microlith; b=blade; bc=blade core; gs=grinding stone
3. D=Dahthami style; SH=Surre-Hanakiya; GEO=geometric (see Ch.6 for details)
* the depth of EjJu17, and the height of EjJu22 and EjJu36 could not be determined

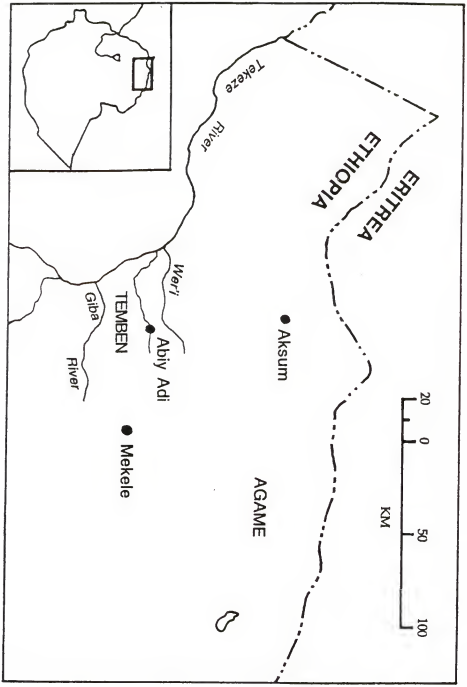


Fig. 1.1 Map showing location of the study area

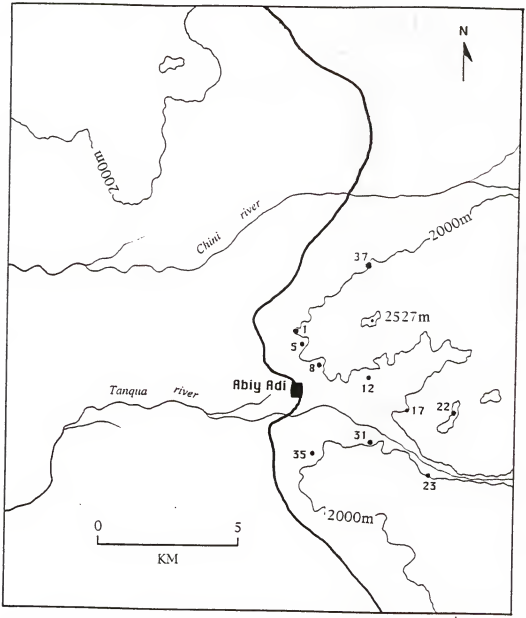


Fig. 1.2 Map showing location of some of the sites in Temben (numbers refer to SASES coordinates).

CHAPTER 2
THE GEOLOGICAL, ENVIRONMENTAL, AND CULTURAL BACKGROUND

The hypotheses related to the origins and development of the Neolithic of Ethiopia, discussed in chapter one, can be better understood by taking an excursion into the environmental/climatic history of the region. Accordingly, this chapter is a brief overview of the general geology and physical setting of Ethiopia. It also discusses the present and past climate/environment of the region. As discussed below the distribution of pasture and fertile soils along climatic and vegetational gradients have influenced the distribution of contemporary pastoralism and agriculture, and no doubt would have done so in the past as well.

Although the archaeological excavations that are the basis of this dissertation are from northern Ethiopia, the paleoenvironmental discussions that follow are mainly focused on central and southeastern Ethiopia. This is because little paleoenvironmental research has been conducted in northern Ethiopia and much of the Late Quaternary environmental history comes from central and

southeastern Ethiopia. However, I have tried to focus on northern Ethiopia when such information is available.

The Geological Background

Because the geology of Ethiopia is very complex, the following discussion is only an outline of the geological history of the region. The oldest rocks in Ethiopia belong to a pre-Cambrian strata, and are usually referred to as the "basement complex", as they are found overlain by subsequent rocks of more recent times (Mohr 1971). They are predominantly composed of metamorphic, metasedimentary, and metavolcanic rocks that are often found exposed in the northern, southwestern, and eastern parts of the country. Denudation and peneplanation characterize the subsequent Paleozoic era and the next major sedimentary deposits occur during the Mesozoic (Mohr 1971).

In northern Ethiopia, such sedimentary succession unconformably overlies the basement pre-Cambrian rocks forming a near-circular area centered around Mekele, the capital of Tigray, and is referred to as the Mekele Outlier (Bosellini et al. 1997). The stratigraphy of the Mekele Outlier consists of a limestone succession that is sandwiched in between lower and upper sandstone units. The upper sandstone unit, called the Amba Aradom formation, is

comprised of conglomerates and sandstones. It is separated from the underlying limestone formation by angular unconformity. The limestone unit, however, conformably rests on the lower sandstone formation (Bosellini et al. 1997; Martire et al. 1997).

The lower sandstone unit, called the Adigrat Sandstone, dates to the Triassic-Jurassic. It has variable thickness across Ethiopia, having 80-90 m and 200 m thickness in the Harar and Chercher highlands of eastern Ethiopia respectively, 500 m in central Ethiopia, and 1000 m in Tigray (Mohr 1961). This maximum thickness for the Adigrat Sandstone in Tigray is centered in the vicinity of Abiy Adi in Temben (Bosellini et al. 1997). These mountains are dotted with caves and rock shelters. While many of these have unexcavatable rocky floors others have sediment deposits, the excavation of some of which is the basis of this dissertation.

The youngest rocks in northern Ethiopia are Tertiary volcanic rocks dominated by basalt that unconformably overlie the Mesozoic sedimentary succession. They are generally of Oligocene to Miocene in age (Mohr 1961). Two groups are often recognized: the earlier Hashenge group which is often inclined and the succeeding horizontally bedded Magdala group (Abul-Hagag 1961). The former varies

in thickness from 70 m in central Ethiopia to 1200 m around Korem, near the present lake of Hashenge in Tigray. The Magdala group also has variable thickness: while it is thin around Korem (300 m) it becomes progressively thicker towards the west at the Semien mountains (Abul-Hagag 1961; Mohr 1961). As discussed in chapters3 through 5, these volcanites are locally and extensively available in the Temben region, and comprised raw materials for some of the artifacts made by the prehistoric inhabitants.

The Physical Setting

Ethiopia is a region of diverse topographic features. The highlands over 1500m comprise nearly 45% (535,000km^2) of the total area of 1.22 million km^2 of Ethiopia, and about 50% of the total equivalent elevation in Africa (Daniel 1988; Grojean and Messerli 1988; Hunri 1988). Altitude ranges from more than 4600 m above sea level to more than a hundred meters below sea level across a short distance. Such features have compelled investigators to divide the country into "relief regimes." However, these investigators use different parameters and as a result their classifications vary widely. While some tend to generalize others use numerous variables and consequently describe many physiographic regimes. For instance Last (1961),

excluding his sub-divisions, divides Ethiopia into 26 relief regions. However, most Ethiopianists adhere to Mesfin's (1970) classification scheme of three major physiographic regimes: the northwestern highlands and associated lowlands, the southeastern highlands and associated lowlands, and the rift system.

The northwestern highlands and associated lowlands are bounded by the western rift escarpments to the east and by a gentle slope towards the Ethio-Sudanese border in the west. These are subdivided into the Tigrayan plateau, the north-central massifs, and the southwestern plateau. This physiographic regime consists of mountains that are commonly cut by deep valleys and drained by rivers. The Abay (Blue Nile) river, for instance, lies for much of its course in Ethiopia in deeply cut valleys. This can be seen from the general descent that the river makes from its source at Lake Tana at 1829 m to an altitude of less than 500m when it enters the Sudan (Rzoska 1978). This physiographic regime is drained by rivers, some of which cross international boundaries and flow to the Mediterranean.

The southeastern highlands and associated lowlands is a physiographic regime that includes the Arssi Bale Massifs of southeastern Ethiopia as well as the Harar Plateau and

Ogaden lowlands in eastern Ethiopia. At 4308 m above sea level, Mt. Batu forms the highest peak amongst the former but there are other several mountain tops that rise above 4000 m (National Atlas of Ethiopia 1988). The Harar plateau extends to northern Somalia but in a gently sloping fashion. The lowlands are to be found to the south and southeast of this physiographic regime.

These two physiographic regimes are separated by the Ethiopian Rift system. The rift system runs from east Africa north into southern Ethiopia where it takes a north-northeast direction until it reaches the Afar Triangle, commonly known as the Afar Depression. It is wide at the Afar Depression while its narrowest point in the central rift valley is only 60-70 km wide (National Atlas of Ethiopia 1988). The rift is home to many lakes that have yielded paleoenvironmental evidence. From north to south the lakes that have been subjected to late Quaternary environmental investigation include Afrera, Asal, Abhe, Beseka, Ziway, Abiyata, Langano, Shala, Tilo, and Chew Bahir.

On the basis of drainage, these lakes can conveniently be divided into four groups. The Afar Rift lakes, consisting of Afrera, Asal, Abhe, and Beseka; the Central Rift Basin consisting of Lakes Ziway, Abiyata, Langano, and

Shala; the Awasa basin lakes of Awasa and Tilo; and the Southern Rift Basin comprising the lakes Abaya, Chamo, and Chew Bahir. Table 2.1 shows the varying depths, area covers, and the water volume of these lakes. The table also shows a general elevation resemblance of the lakes of each basin to each other with the exception of Lakes Beseka from the Afar Rift and Chew Bahir from the Southern Rift. Thus the Afar Rift lakes, with the exception of Beseka (955 m asl), are below or close to sea level in elevation; the Central Rift lakes are bracketed by 1558-1636 m; and the Southern Rift lakes mainly center around 1200 m (except Chew Bahir at 520 m asl).

Table 2.1 Some data on the lakes mentioned in the text

	Elevation in meters	Maximum depth(in m.)	Area in sq. km
The Afar basin lakes			
Afrera	-80	n.a.	70
Abhe	240	37	350
Asal	-155	20	55
Besaka	955	n.a.	7
The Central Rift lakes			
Ziway	1635	7	434
Langano	1585	46	230
Abiyata	1580	14	205
Shala	1550	266	409
The Awasa basin lakes			
Awasa	1675	22	92
Tilo	1545	11	64ha
The Southern Rift lakes			
Abaya	1285	13	1070
Chamo	1233	13	350
Chew Bahir	520	ephemeral	ephemeral

Source:- Gasse et al 1980; Telford and Lamb 1999; Tesfaye 1982

Located in one of the hottest (if not the hottest) areas on earth, the Afar Rift lakes are bounded by the Lake Afrera in the north and continue in a SSW direction to Lake Beseka of central Afar. They are located in the widest part of the rift where it has a triangular shape but which begins to narrow at or just south of Beseka.

The Central Rift Basin has been called as either the "Gala lakes region" or the "Ziway-Shala basin". While the former carries a pejorative connotation (the name Gala has been discarded, and the people prefer the term Oromo), the latter is not an all inclusive term. Therefore I propose to drop these terms here and to use a neutral geographic term: the Central Rift lakes region or basin. Located at the center of the Main Ethiopian Rift, the lakes of this region are bounded by the Arssi-Bale Massifs in the east and the Central Ethiopian Plateau in the west that are separated by 70-90 km (Tesfaye 1982). This region has higher elevation in the rift, a fact seen from the surface altitude of the lakes (Table 2.1). Sandy, lateritic clayey, and dark clayey soils are the three main soil types in this region. The vegetation, except for the grasslands at the escarpments, is composed of woodland and thornbush (Tesfaye 1982).

Exceptions within the central rift system are Lake Awasa and Lake Tilo. Despite their proximity to the rest of

the central rift lakes, these lakes have their own drainage basin quite separate from the above and the catchment area can be labeled the Awasa basin.

The southern Rift lakes constitute a separate drainage and contains all the southern lakes: Lake Abaya (previously known as Lake Marghareta), Lake Chamo (previously known as Lake Ruspoli), and Lake Chew Bahir (previously known as Lake Stephanie), the only lake from this basin that has provided paleoclimatic evidence.

Climate and Vegetation

Climate and vegetation are shaped by many factors, but in Ethiopia the effect of altitude on the distribution of rainfall and vegetation can not be overestimated. Altitude is traditionally divided into the following agroclimatic zones: Wurch (alpine), Dega (literally temperate), Weina Dega (sub-tropical), Qolla (tropical), and Bereha (desert). According to the National Atlas of Ethiopia (1988) wurch covers all areas that are over 3300 m, dega from 2300 to 3300 m, weina dega 1500-2300 m, qolla 500-1500 m, and bereha less than 500 m.

According to this classification scheme the Red Sea littoral and the Afar Depression are berehas, while to the west, places like the Semien mountains, that reach as high

as 4600 m above sea level, are classified as wurch. Such altitudinal divisions are also reflected in the thermal divisions of the country (Fig. 2.1). The qolla and bereha zones are much hotter than the other agro-climatic zones. Moreover, the dega and weina dega agroclimatic zones get higher rainfall than the qolla and bereha . Thus the Red Sea littoral, the Afar Depression and the Ethiopian-Sudanese borderland receive lower rainfall than the highlands (Fig. 2.2). Furthermore, in the Ethiopian lowlands (including the Ethio-Sudanese borderland) rainfall is variable and less reliable (Daniel 1977).

Figure 2.2 shows the distribution of rainfall across Ethiopia. The maximum rainfall occurs in southwestern Ethiopia where mean annual rainfall is more than 2000mm/year. Another rainfall maximum occurs in some parts of southern Ethiopia. However, there is a marked decrease in rainfall at the eastern and northeastern parts of the country. Furthermore, the timing and duration of rainfall varies. Thus, while southwestern Ethiopia is an all year rainfall area, other parts of the country generally get rainfall either during summer or winter (Mesfin 1970; National Atlas of Ethiopia 1988)

Most of the rain in Ethiopia falls during the summer and is dependent upon the migration of the Inter-Tropical

Convergence Zone (ITCZ) which passes through Ethiopia twice a year, and heralds the onset and withdrawal of the rains (National Atlas of Ethiopia 1988). In July the ITCZ is positioned just to the north of Ethiopia. The prevailing winds at this time are the south-westerlies. Originating in the Atlantic Ocean, these prevailing winds cut through the Gulf of Guinea, through Congo into Ethiopia, and bring with them a moisture-laden air stream that heralds the onset of the rainy season, the kiremt. In Ethiopia, these air streams pass through the southwestern highlands where they cause heavy rains, but the amount of rainfall decreases by the time these air streams reach northeastern Ethiopia. Thus, while southwest Ethiopia has a longer rainy season and more rainfall, north Ethiopia has only two or three months of rainfall in most places.

During the bega season, the dry period, which is generally between November to April, the ITCZ has moved to the south, and much of Ethiopia is under the influence of the North-East Trade winds that originate in Southwest Asia. These winds have little moisture and deliver scant rain along the Red Sea coast and adjacent northern escarpments of the rift, but beyond this they have minimal or no effect (National Atlas of Ethiopia 1988).

The foregoing is a simplistic rendering of the rainfall pattern in Ethiopia. While it provides a general scenario there are other factors that affect the distribution of rainfall patterns. Besides the fluctuating positions of the ITCZ which bring Ethiopia under the influence of various air streams, rainfall in Ethiopia is also highly affected by relief (Daniel 1977; Last 1962; Mesfin 1970). Thus, rainfall decreases with altitude towards the lowlands, and many valleys that cut the highlands generally lie in the rainshadow. Moreover, the striking relief of the country results in differential localized currents that may influence variations in rainfall patterns. For instance, western Addis Ababa receives higher rainfall than eastern Addis Ababa (Last 1962). Such rainfall patterns coupled with vegetation have influenced human activity in the region, and no doubt, would have affected the settlement pattern of prehistoric populations.

These variations in relief and rainfall have brought about differences in natural vegetational belts. Vegetation gradients are more pronounced along steep rather than gentle slopes (Beals 1969). The fact that rainfall ranges from less than 100 mm in the Afar depression to more than 1500 mm in the highlands has brought about a vegetational

range of desert or near-desert environments in the former and alpine vegetation in the latter.

Thus in the bereha parts of the Afar depression, which have long been economically linked to the northern highlands through salt trade, there is very little or no natural vegetation "except along drainage lines where flood water from the highlands spills out onto the desert, or where runoff from the occasional rain may gather and stay sufficiently long for plant establishment" (Wilson 1977:254). These are replaced by deciduous woodland dominated by *Acacia* spp. in the qolla areas at altitudes between 800-1500 m asl (Daniel 1977). Today pastoralism is the dominant form of human activity in these qolla agroclimatic zones.

Above this elevation to ca. 2500 m, the weina dega agroclimatic zone, is to be found montane savanna grassland which is now extensively and intensively used for grazing and/or agriculture. Based on historical sources it is believed that this altitude range encompassed evergreen forest in the recent past (Pankhurst 1990, 1995). Today, however, only some parts of southeastern and southwestern Ethiopia are covered with such intact forests (Tewelde 1988). Nowhere is the depletion of natural vegetation as clearly visible as in northern Ethiopia, where presently,

only remnants of these forests are found. Humans there have cleared the vegetation mainly for agricultural purposes, but also for fuel and construction, in a region that has been the heart of the Aksumite empire since at least 2500 years ago.

In any case, in the weina dega zones of northern Ethiopia, remnants of Juniperus and Podocarpus trees with some Olea spp. are found usually in steep valleys or church compounds that are beyond human reach (Yemane and Mekonnen 1995). Also in northern Ethiopia wild edible fruits are commonly found interspersed with these remnants. These include awhi (Cordia africana), giba (Ziziphus spina-christi), shagla (Focus sycomorus), mull'o (Ximenia americana) and kumel (Mimusops kummel). Some of these, in addition to their fruits being consumed, are used for "live fence". Others (e.g., shagla) have wide canopy and provide good shade where local meetings in villages are sometimes held (pers. obs.).

Amare's (1974) investigation into the wild tubers and fruits of Ethiopia has indicated that many of these have a role in the native diet. He states that although under normal circumstances they are consumed by shepherds, these items indeed become part of the diet of all ages and sexes in times of famine or heightened drought periods. These

plant foods, no doubt, would have been readily available to the prehistoric inhabitants of the region.

Still at higher altitudes, in the wurch agroclimatic zone, large tracts of land are covered by Afro-alpine vegetation. Although specific orographic and edaphic conditions may influence the actual timber limit the elevation of 3200-3500 m is generally considered the upper limit (Uhlig 1988; Uhlig and Uhlig 1991). At and above this elevation, Euracreae vegetation that is short, slow growing, and adapted to cold environment is predominant (Tewelde 1988). Much of the wurch summits are covered with steppe vegetation and mountain grass (Azene 1993). Human activity is restricted to grazing (Tewelde 1988) with very limited agriculture, which is not practiced above 3700 m asl (Azene 1993).

The Cultural Background to Contemporary Northern Ethiopia

The cultural diversity of modern northern Ethiopia has shaped the construction of various theories on the origins and development of the northern Ethiopian Neolithic. For the purposes of this dissertation, northern Ethiopia is defined as Lake Tana north to the Eritrean border, west to the border of Sudan, and east to the Afar Rift. Ranging in elevation from less than 100 m below sea level to greater

than 4000 m, the northern Ethiopian highlands are characterized by steep mountain peaks, rolling plateaus and flat mesas dotted with fertile valleys. Rainfall varies from 200-1500 mm/year, with altitude being the most important factor affecting climate as well as vegetation and agricultural productivity.

Based on elevation, three major agro/ecological zones are traditionally recognized: 1) dega, the arable but cool highlands above 2400 m, characterized by natural sub-alpine and alpine vegetation; 2) weina dega, the prime agricultural zone situated between 1500 and 2400 m which has largely been stripped of its natural vegetation through extensive deforestation and 3) qolla, the warmer and drier lowlands lying below 1500 m and characterized by xerophilous open woodland and steppe short shrub vegetation (Daniel 1977; Mesfin 1970; White 1983). Toward the Ethio-Sudanese borderlands in the west, mountains and valleys of the dega and weina dega give way to the gently descending hills and lowlands of the qolla, while to the east steep escarpments descend abruptly to the very hot and very dry Afar Depression and Red Sea littoral, where elevations can be 100 m or more below sea level (Last 1962; Barbour 1964).

Today the northern dega and weina dega highlands are occupied largely by Ethio-Semitic speaking Tigrayan and

Amhara farmers as well as small pockets of Central Cushitic speaking Agew farmers who practice intensive agriculture based upon the sowing of cereals, pulses, and oil crops (Amare 1978; Levine 1974; Westphal 1975). Teff is the most important grain in terms of food and area grown, and is the most carefully cultivated. It tolerates waterlogging, grows well during the short but cool rainy season, and is generally resistant to most pests and diseases (Huffnagel 1961:181,182; Westphal 1975:94). Teff is grown almost exclusively in the weina dega zone, along with such other cereals as finger millet and a variety of oil crops and pulses. Near Eastern cultigens such as wheat and barley also play an important role in cereal production.

The most important implement of cultivation is the plow or maresha (McCann 1995). Although investigators believe that the maresha is of considerable antiquity, there is no consensus on how old it actually is. Clark (1976, 1980) maintains that the plow together with wheat and barley was introduced from the Near East by Sabean immigrants around 500 BC. Clark (1976) relates this to the plowing scene found at the rock art site of Ba'ati Focada in northern Ethiopia, a rock art site whose date is uncertain. The rock art site in question contains a human figure plowing with two humpless cattle (Drew 1954; and

pers obs). Other paintings in the panel show only hunting scenes. This rock art may well be therefore included with the early styles that date to between 5000 and 3000 years ago. Other investigators are in favor of the a much earlier date for the plow. Goe (1989:108), for instance, maintains that evidence from early cattle migrations favor the existence of the plow "much earlier than 1000 BC" while Simoons (1960, 1965) suggests that the northern Cushites "had the plough ... in pre-Semitic times" (1965:12). Ehret (1979) goes even further to state that it was present in northern Ethiopia several millennia prior to the "arrival of the Sabeans." However, independent evidence that supports this linguistic testimony is lacking.

In any case, the maresha is made of "a bent wooden beam, with a triangular piece of wood serving as a sledge on each side; in front of the beam is a yoke, its other end slightly widened and has a vertical hole for the steering stick with a metal point that penetrates the soil" (Westphal 1975:90). Usually pulled by a pair of oxen, it breaks rather than turns the soil, thus repeated plowing is necessary before an adequate seedbed is achieved. Land is cleared and repeatedly plowed before sowing begins. Sowing starts with the beginning of the small rains in April, and/or in late May and June just before the onset of the

major rainy season. Harvesting takes place from September through November (Simoons 1960).

In the qolla lowlands to the west and northwest, Eastern-Sudanic speaking farmers traditionally use the hoe and digging stick to grow a wide range of more arid-adapted crops such as sorghum, as well as graze their cattle and ovicaprid herds. Also in this region Northern Cushitic speaking Beja nomadic pastoralists trade with the farmers and make use of seasonally available forage to feed their camels and cattle. Some of these Eritrean pastoralists have been observed in the Temben region as late as the mid-1990's (Yemane and Mekonnen 1995). To the east in the Afar Rift, seasonal variability in water resources forces the Eastern Cushitic speaking Saho and Afar nomadic pastoralists to move their herds of cattle, ovicaprids, and/or camels between the Afar Rift and the Tigrayan plateau (Parker 1971; Pastner 1984). The Afar engage in trade with the highlanders, providing them with salt in return for grain, something they have done since "time immemorial" (Abir 1966:7). The livelihood of the Saho also involves seasonal movement. In the winter they move to the coast, while in the summer they return west to the escarpment, with some of them moving up and eventually settling on the Tigrayan Plateau. When the Saho move to the

coast they also take the Tigrayan farmers' livestock to graze in exchange for grain (Lewis 1969).

Climates/Environments of the Holocene

Much of the information on paleoclimates in Ethiopia is derived from lake cores and the identification and dating of previous high shorelines of the lakes. Observations of such ancient lake level variations began with Nilsson's (1931, 1940) investigations. His climatic phases remain undated as the study was undertaken before the development of chronometric dating. Recent investigations (Gasse 1977; Gasse and Street 1978; Gasse et al. 1980; Grove and Dekker 1976; Grove and Street 1978; Grove et al. 1975; Lamb et al. 2000; Leng et al. 1999; Telford and Lamb 1999; Street 1979, 1980; Street-Perrot and Perrot 1993; Williams et al. 1977, 1981) have added to the repertoire of our understanding of the chronology of these lake level oscillations during the Late Pleistocene and Holocene.

Other environmental studies that focused on palynology (Bonnefille and Mohammed 1994; Bonnefille et al. 1986; Hamilton 1982; Mohammed 1994; Mohammed and Bonnefille 1994) or geomorphology (Beraki et al. 1998; Brancaccio et al. 1997; Butzer 1981, 1982; Hastenrath 1977; Hunri 1989;

Potter 1976) have allowed at least a preliminary reconstruction of vegetation history. Indeed, there have been more and better detailed late Quaternary environmental investigations than the complementary archaeological research of the time period.

After the aridity of the Late Pleistocene, many of the Ethiopian lakes were much higher during the Early to Mid-Holocene than their present shorelines. Lake Abhe, for instance, which was dry between 17 to 12,000 years ago, rose 160 m above its present shorelines to reach 400 m asl (Gasse 1977; Gasse et al. 1980). It continued to have a high stand until 6500 BP but started rapidly dropping by 4000 BP (Gasse et al. 1980). Other lakes in the Afar region also rose during this time. Thus, Lake Asal rose to more than 112 m asl (from its present 155 m below sea level elevation) by 10-6,000 BP (Gasse 1977; Gasse et al 1980). Lake Afrera, another one of the Afar lakes, also surged some 40 m during the early Holocene from its present levels to have an estimated volume increase of 12 cubic kilo meters (Gasse and Street 1978). A similar record is preserved at Lake Beseka. Fossiliferous diatomite deposits 10 m above its present levels that date to the Early Holocene indicate that the lake had risen to that level. However, by the beginning of the mid-Holocene the lake

started regressing, never to attain that level again (Brandt 1982; Williams et al. 1977).

Farther south, the Central Rift Basin lakes (usually referred to as the Ziway-Shala lakes) also experienced climatic fluctuation from the end of the Pleistocene to the Holocene. After the Terminal Pleistocene arid phase, which lasted to around 11,000 years ago, there were two major Holocene high stands in the central rift basin with an intervening regression between 8500-6500 BP. During these two major transgressions the four present-day lakes formed a single lake, increased in level by at least 112 m above present day Lake Shala, and indeed overflowed to the Awash river system, through which they were linked to lake Abhe (Gasse et al. 1980; Grove and Street 1978; Grove et al. 1975; Street 1980).

Although there are indications of high lake level shorelines at 10, 22, 33, and 40 m above the present surface of Lake Awasa these shores remain undated as the sediments lack organic datable remains (Grove et al. 1975). However, recent research in a nearby lake has indicated high early Holocene precipitation. A 23 m core taken from Lake Tilo has shown a change from early Holocene freshwater conditions to increasing salinity by mid-Holocene times beginning at 4500 BP. Investigators believe that these

changes occurred as a result of changes from humid to arid conditions (Lamb et al. 2000; Telford and Lamb 1999).

Lake Chew Bahir is the only southern Rift lake that has provided radiometric dates of its transgression. A single radiocarbon date on an oyster shell (Etheria elliptica) 20 m above the present levels of Chew Bahir (5660±110 BP) indicates that the lake was higher than its present levels. The sharp upper limit of the lake is indicates overflow into Lake Turkana by the early to mid-Holocene times. Lake Abaya is still linked to Lake Chamo by a stream. However, during the early Holocene these lakes were thought to have overflown to Chew Bahir: water spilled from Chamo to the river Sagan, which linked Chamo to Chew Bahir. After the mid-Holocene, Lake Chew Bahir became ephemeral, and historical records indicate fluctuations. Its overflow during the early to mid-Holocene has been partly attributed to the increased runoff that the lake was receiving from the rivers draining the highlands of central Ethiopia (Grove et al. 1975).

Increases in the levels of the Ethiopian lakes have been attributed to the increased rainfall during the Early Holocene. Street (1980:143) states that such high lake levels at a time when temperatures were equal or higher than present "would require an increase in mean annual

runoff on the order of 50%". Likewise, Grove and Dekker (1976) estimate a 30% increase in the amount of rainfall at the catchment area in the Central Rift lakes during the early Holocene. More recent investigations have corroborated the estimates of high rainfall during the early Holocene (Leng et al. 1999).

These investigations are complemented by studies from other east African lakes. To maintain the enlarged lakes of Turkana, Nakuru-Elementeita, and Naivasha between 10,000 to 7,000 years ago would have required a rainfall "at least 150-300mm/yr (15 to 35%) above the modern averages" (Hasternath and Kutzback 1983:151). Indeed Hasternath and Kutzback (1983) say that this is a conservative estimate and they did not account for the overflow of lake Turkana to the Nile system at this time (Butzer et al. 1972). Water balance models for a nearby lake Naivasha, also in Kenya, also indicate a 55% increase in precipitation in the area during the early Holocene times (Vincent et al. 1989).

These climatic fluctuations reflected in the lake levels are also evident in other environmental parameters such as temperature. However, estimates of temperature vary widely: Late Pleistocene temperatures in Africa were 5°C cooler than today according to Grove (1993), but 6 to 9°C cooler according to Maley (1993). Despite such disparities

in estimates of the magnitude of temperature change, investigators agree that the Late Pleistocene was cooler than the present (Bradley 1985; CLIMAP 1978; Crowley and North 1991). Such cool temperatures allowed glaciers to be 1000 m lower than their present position (Grove 1993), a proposition that is widely accepted for global averages (Bradley 1985).

Such glaciation was recorded in the high mountains of Ethiopia. Hunri (1989) states that the Semien mountains were capped by glaciers that extended down to 3750 m from 4620 m. The glacial morphology is most pronounced on the northwestern and western sections of the mountains. Although actual radiometric dates for this are lacking, Hunri (1989) maintains that these glaciers occurred between 20-12,000 years ago. However, there is no evidence of glaciation in northern Ethiopia beyond the Semien mountains even though there are other peaks that rise to or above 4000 m asl (Hunri 1989).

However, despite their proximity to the equator, the largest ice caps were to be found in southeastern Ethiopia in the Arssi-Bale mountains. Potter (1976) states that Mount Bada was ice-capped to 350 m below its summit with glaciers that covered an area of at least 140 km^2; while Hastenrath (1977) maintains that Mt. Chilalo, Mt. Kakka,

and Mt. Enkwolo were covered with glaciers. The total area covered by these glaciers is estimated to be 19, 18, and 2 km^2 respectively (Gasse et al. 1980). These estimates seem to be conservative to Messerli and Winiger (1980, 1992) who maintain that the total area covered by ice in the Bale mountains exceeded 600 km^2. In any case, by 11,500 BP these glaciers had disappeared (Gasse et al. 1980).

These glaciers did not just result in lower vegetation lines (Hunri 1989) but also in less vegetation cover even at lower altitudes (Adamson et al. 1980). However, ensuing warmer temperatures melted the glaciers and allowed montane forests to recover (Williamson and Adamson 1980).

In northern Ethiopia recent geomorphological research on incised and exposed sections of river banks at Adi Kolen, Mai Mekden, and Shiket (ca. 15 km SW, 9 km N, and 50 km E of Mekele respectively) has shed some light on the vegetation history of the early to mid-Holocene (Beraki et al. 1998; Brancaccio et al. 1977). Buried soils at Adi Kolen date from 8300±100 BP to 6730±90 BP; while those of Mai Mekden are bracketed by radiometric determinations from a lower and upper layer of a buried soil dating to 7310±90 and 5160±80 BP respectively, the latter marking the end of soil formation. At Shiket, however, soil formation did not

end until 4480±70 BP indicating the persistence of vegetation cover to the mid-Holocene. The dates of initial soil formation are not known, but the investigators suggest that it started "probably during the more humid and mild climatic conditions at the end of the last glacial" (Brancaccio et al. 1997:34).

Beraki et al. (1998:136) and Brancaccio et al. (1997:30) state that the year 5160±80 BP at Mai Mekden forms the end of travertine formation. The deposits above this layer are covered with alluvial and colluvial sediments that were being eroded from nearby slopes due to pronounced denudation, partly caused by human clearing of the vegetation. However, such a hypothesis needs to be supported by archaeological evidence and confirmed by further paleoenvironmental investigation before it can be taken as conclusive. Although these investigators say that they found "dwelling structures and ceramic fragments of undefined age at the base of the alluvial-colluvial deposits" (Beraki et al.1998:136) these remain undated and are therefore of questionable antiquity. To be fair, the archaeological hypotheses for the Neolithic of Ethiopia discussed in the preceding chapter argue for the beginnings of at least an incipient agriculture by this time. However the magnitude of such agriculture and its effects on

landscape use and vegetation clearing remain to be seen. Therefore the date must be viewed cautiously particularly as the same investigation has shown the persistence of vegetation cover that lasted up to 3880±70 BP at a nearby locality (Brancaccio et al. 1977:35).

Elsewhere in Ethiopia, data recovered from lakes and peat bog cores has indicated evidence of Holocene vegetation cover at higher altitudes than tree lines of the Pleistocene. At Mt. Badda (4000 m) in eastern Ethiopia, for example, montane alpine taxa dominated the pollen spectra of the early Holocene (Hamilton 1982). This 3 m core extends from recent times to pre-10,000 years ago. Although there was scanty deposition by 6-7000 years ago, the pollens of Urticaceae are at their peak and this has been interpreted as extension of forests. Persistence of this condition to the mid-Holocene is also evident farther south at Mt. Danka (3830 m) (Hamilton 1982). This core covers the last 8000 years, the earliest deposits of which show evidence of abundant trees dependent upon heavy precipitaiton. These indicate that tree lines were pushed higher than their pre- or terminal Pleistocene levels.

A similar investigation at Lake Abiyata (1585 m) has shown a vegetation dominated by Afro-montane taxa by 9000 BP. This situation also continued until at least 6000 BP,

when the pollen spectra are comprised of "almost exclusively montane forest taxa" (Street-Perrot and Perrot 1993:335). This indicates that such taxa expanded even to the escarpments of the Rift Valley as a result of the wet conditions of the early to mid-Holocene.

From the Mid-Holocene onwards, however, with the exception of the short wet spell of 2500-1500 years ago, the levels of many of the lakes began to decrease, and some (e.g., Chew Bahir) became ephemeral. During the mid-Holocene and particularly after 4000 BP, Lake Abhe fell rapidly to reach its present levels. Lake Asal also started to recede after 6000 BP, plummeting to 100 m below sea level by 5600-5300 BP (Gasse and Street 1978). Likewise, by 4800 BP the single paleolake of the central rift basin shrunk to form four different lakes and never regained its earlier high stand. This situation has been demonstrated elsewhere in Africa. For instance, Lake Turkana in Kenya, which had overflowed to the Nile system previously, shrunk to its lowest levels by this time (Butzer et al. 1972).

The exception to these dry conditions is between 2500-1500 BP where there has been a progression of lake levels. Lake Abhe, which had been rapidly dropping, rose to 320 m between 2700 and 1000 BP (Gasse et al. 1980), as did lake Asal which attained some 20 m during this time, a situation

that was paralleled in the Central Rift lakes (Gasse and Street 1978). Geomorphological research by Butzer (1981) has indicated that by 2000 BP there was higher rainfall with longer duration in northern Ethiopia, which allowed the production of crops that sustained the Aksumite empire of the time. Similar evidence for high rainfall comes from a small crater lake to the north of Langano. The bottom of a 6m core taken from Lake Wenchi has shown evidence of high precipitation by 1720 ± 80 BP (Bonnefille et al 1986). The result of such a humid climate with increased precipitation brought about the revival of Podocarpus forest elsewhere in the rift valley (Mohammed and Bonnefille 1991).

However, this was a short lived phenomenon as by 1500 BP arid conditions resembling those of today had been established (Bonnefille et al. 1986). By this time soil erosion that had began earlier as a combined result of natural factors and human clearing of vegetation, was exacerbated with the intensification of agriculture necessary to sustain a large state level state society in northern Ethiopia (Bard et al. 2000; Fattovich et al. 2000). Massive changes in vegetation, particularly a marked destruction of Podocarpus trees as a result of human cultivation dating to 1850 BP is also seen from the Mt. Badda pollens. Such high altitude human disturbance of the

vegetation is also reflected from pollen analysis at Mt. Dinka in the Arssi-Bale massifs (Hamilton 1982).

General Summary

This chapter has dwelt on the contemporary geographical setting of Ethiopia and has attempted to look into the present and past environments of the region. It has assessed the altitudinal gradient in rainfall and vegetation distribution and has reviewed the past climatic and environmental scenario.

One observation that is clear in the literature is that not all forms of paleoclimatic/paleoenvironmental investigations necessarily agree on the timing and profundity of the climatic changes of the Holocene. This is particularly surprising because the Holocene is well within the reach of radiocarbon dating. Investigators suggest that such discrepancies that are apparent in the climatic reconstruction can be a result of the scale of resolution of the investigations, the "continuity of the record, the nature of the proxy, and the climate parameter recorded" (Mohammed 1994:730-731).

Be that as it may, the foregoing discussion depicts a general picture of wet and dry periods that are recorded by lake level fluctuations. Thus, during the Late Pleistocene

lakes were much lower than their present levels while the subsequent rains of the Early Holocene brought about the filling, and sometimes the overflow, of some lakes. This increased rainfall and warmer temperatures of the Early Holocene also brought about the increase of the extent of forest cover to beyond their pre-Holocene boundaries.

This early Holocene wet phase, as it is generally labeled, continued (with minor local variations) almost to the mid-Holocene, when there is evidence of drier conditions. The present climatic conditions are believed to have been firmly established some 4000 years ago, with an intermediate wet and humid phase between 2500-1500 BP, a time period that saw the development of complex civilizations in the region.

The climatic fluctuations discussed above must have created fluctuating altitudinal zonation of resources that in turn must have had a profound effect on the adaptation of the prehistoric inhabitants of the region. We do not know the effects of these climatic fluctuations on the prehistoric inhabitants of the region because of the paucity of archaeological investigations pertinent to this time period.

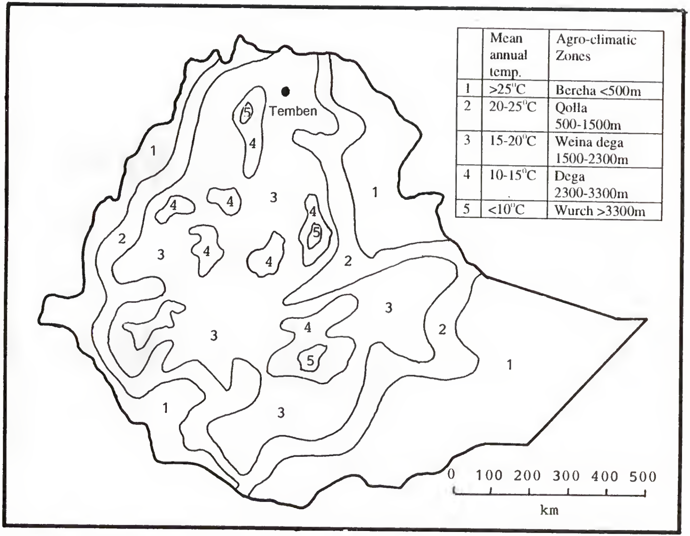
The breadth and depth of different ecological zones that must have ensued as a result of climatic fluctuations would have affected the subsistence options that were available to the prehistoric inhabitants of the region. During the drier conditions of the Terminal Pleistocene, for instance, there would have been harsh conditions due to the glaciers in the upper altitudinal zones which would have pushed the settlement pattern to lower altitudinal zones. During the early Holocene, however, higher rainfall and more vegetational cover would have made more resources available to the inhabitants, who then would have been less mobile and more sedentary.

Unfortunately, however, although we have a better understanding of the climatic history of the region the complementary archaeological investigations are lacking. As can be seen from the discussions in chapter one, there is clearly a dearth of archaeological data relevant to the understanding of the Holocene cultural "developments" in northern Ethiopia. The paucity of archaeological research means that the above hypotheses for the origins and development of food production in Ethiopia (or for that matter, those developed for other regions of the world) have not been sufficiently examined. Consequently, we know virtually nothing about how, when, where, and why

indigenous Ethiopian hunter-gatherers took up a food-producing way of life. The climatic fluctuations in the region in the Late Pleistocene and Holocene can tentatively be outlined but we know virtually nothing of how hunter-gatherers adapted to the consequent resource changes that may have resulted. We know that people led a food producing way of life but we still lack an understanding of the processes leading to the transition. Investigators have argued for the introduction of food production as a result of migrating pastoralists, but such hypotheses give little attention to the in situ developments of an Ethiopian Neolithic socio-economy. Inter-regional hunter-gatherer/farmer/pastoral interactions (Gregg 1988; Spielmann 1986; Spielmann et al. 1990) were probably important to these developments, but this has not been explicitly examined in archaeological research. To address these issues requires problem-oriented research at sites which can provide radiometrically datable stratified cultural sequences containing preserved faunal and floral remains.

Obviously, more multidisciplinary archaeological research is needed to understand the effects of these climatic changes on cultural change in the region. The following discussion of the Temben sites is therefore a

beginning towards the understanding of the cultural developments during the Holocene.



	Mean annual temp.	Agro-climatic Zones
1	>25°C	Bercha <500m
2	20-25°C	Qolla 500-1500m
3	15-20°C	Weina dega 1500-2300m
4	10-15°C	Dega 2300-3300m
5	<10°C	Wurch >3300m

Figure 2.1 Thermal Divisions and Agroclimatic Zonation in Ethiopia (after NAE 1988)

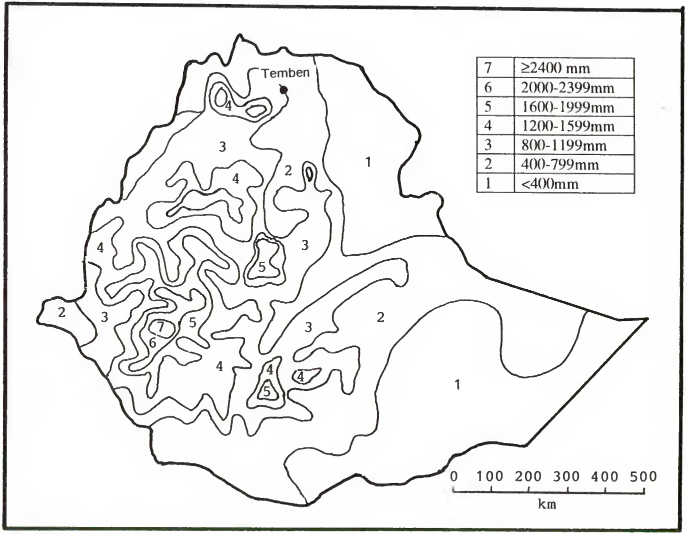


Figure 2.2 Mean Annual Rainfall Distribution across Ethiopia (after NAE 1988)

CHAPTER 3
THE SITE OF DANEI KAWLOS (EjJu 23)

Danei Kawlos is located ca. 5 km southeast of Abiy Adi (Fig 1.2). It is a cave overlooking a narrow river valley and measuring 14 m in length, 8 m in depth, and 4 m in height. Although it is wide it has a small excavatable surface. Time and logistics permitted the excavation of five units, each 1 x 1 m in size (Fig. 3.1), with one of them reaching bedrock at ca.140 cm below surface.

Excavation at test units one and two (TU1 and 2) was stopped at 35cm below surface because they were trampled upon one night by cattle that stayed overnight at the cave. It was therefore necessary to stop excavating these particular squares. Excavation at the next three test units (TU3, TU4, and TU5) was uninterrupted as we started to protect the cave from cattle by fencing it with rocks and by asking local shepherds to deter their livestock from entering the cave. Thus, the site was protected until the end of the field season.

Excavation Procedures

Excavations were undertaken employing the standard conventions of 1 X 1 m grid squares. Levels were defined by arbitrary 5 cm thickness. Each excavated level was carefully photographed and recorded using Munsel soil color charts. The excavated materials were dry sieved using a 1 mm mesh screen that has allowed the recovery of small animal bones.

All recovered materials were sorted, catalogued, and bagged in the field. Detailed artifact analysis was undertaken at the National Museums of Ethiopia in Addis Ababa.

Faunal remains were analyzed by Dr. Fiona Marshall of Washington University and Mr. Jean-Renaud Boisserie of the National Museum/Center Francais des Etudes Etiopiennes in Addis Ababa. Floated soil samples have been sent to Dr. Catherine D'Andrea of Simon Fraser University for seed identification. Soil samples were also submitted to Dr. Mohamed Omar, a palynologist at Addis Ababa University, for palynological analysis.

Lithostratigraphy, Dates, and Associated artifacts

The sediments at Danei Kawlos are dominated by sand (Fig. 3.2). The earliest deposit of the site is

represented by layer 5, a layer of varying thickness. It is composed of a somewhat consolidated light reddish brown (5YR 4/6) sand resting between the bedrock and the overlying layer 4, a red (2.5YR 5/6) silty sand. Charcoal from 95-100 cm below surface from this layer has been radiocarbon dated to 3380 ± 160 BP (GX-27745). Also from this layer a domestic cattle premolar (identified by Dr. F. Marshall) from a depth of 130-135 cm below surface was submitted for direct radiocarbon dating. However, there was not enough collagen left in the specimen to allow such dating.

Layer 5 contains most of the shaped tools of the site that are almost exclusively of obsidian and chert; it also contains the only shaped quartz artifact. Layer 4 also encompasses some shaped tools and some elaborately decorated sherds, which diminish in frequency above this layer and disappear in the upper two layers. It is overlain by Layer 3, a relatively thinner stratum composed of a yellowish red (5YR 4/6) sand. Layer 2 contains plain pottery and no shaped lithic artifacts. It is composed of reddish yellow (7.5YR 6/8) grainy sand. The topmost layer, Layer 1, is of variable thickness and is composed of a strong brown (7.5 YR 4/6) loose coarse sand. The pottery in this layer, like in the stratum immediately below it,

is rather coarse, in the sense that it is not smoothed; the lithic artifacts are largely basalt angular waste or flakes.

The Cultural Materials

Lithic Artifacts

A total of 1163 lithic artifacts were recovered from Danei Kawlos. Table 3.1 provides a complete inventory of the lithic artifacts and Figure 3.3 presents the lithic artifact frequency throughout the excavated sequence. It is interesting to note that the frequency of lithic artifacts diminishes in the upper layers. It does so particularly between ca. 35 cm below surface up to the surface, even though all five units were excavated to that depth. Most of the lithic artifacts are from the two test units (TU3 and 4) that were excavated to more than 65 cm below surface.

Raw Material

Flaked stone artifacts at Danei Kawlos are composed of eight types of raw materials (Table 3.2). Raw material is dominated by chert, followed by obsidian. Basalt and quartz artifacts are concentrated in the upper two stratigraphic layers. Chert is extremely varied in color with black and red colors constituting the most and least

dominant materials respectively (Table 3.3). Evidence of heat treatment of chert raw materials is restricted to the lowest layer.

Although most of the artifacts at Danei Kawlos are dominated by chert, the most frequently used raw material for shaped tools is obsidian (Table 3.4). Obsidian constitutes less than 15% of the total lithic assemblage, but represents 58% of the shaped tools. The rest of the shaped tools are made of chert and chalcedony as there is only one quartz shaped tool. There are no basalt or agate shaped tools, and only two total agate artifacts. Most of the basalt artifacts occur in the upper layers largely as angular waste and flakes.

Sources of Raw Material

Table 3.2 shows the raw materials utilized for artifact manufacturing at Danei Kawlos. Of these basalt, quartz, and sandstone are locally available materials and are mostly represented in the upper two layers of the site. During fieldwork I noticed a few chert nodules along the river bed that passes close to the site, but no agate or obsidian nodules. In any case the presence of some nodules on river beds does not necessarily indicate that

these materials were available for prehistoric inhabitants for "quarrying".

There are no natural outcrops of chert, obsidian, and agate in the immediate vicinity of the site, indeed no such outcrops were identified during the surveys or through "interviews" with local inhabitants. It is interesting to note, however, that there are recent volcanic rocks very close to the town of Abiy Adi from which the obsidian, if existent, may have been brought, and bands of chert layers have been reported from Shiket some 50 km east of the town of Abiy Adi as the crow flies (see Bosellini et al 1997) although the artifacts may not have been necessarily quarried from there.

One way of identifying sources of raw materials is by employing trace element analysis. Although there have been recent advances in the application of trace element analysis to a number of raw materials including marble and chert (see entries in Waelkens et al 1992) the best known case for such a technique is on obsidian (e.g., Cann et al 1970; Merrick and Brown 1984).

While I was analyzing the artifacts at the National Museums of Ethiopia, Dr. Francis Brown of the University of Utah offered his help to do trace element analysis of obsidian samples. As most of the shaped tools from Danei

Kawlos are from obsidian and as there were many tool trimming debris collected from the excavation, it was interesting to see how many sources of obsidian there were. Samples were therefore submitted to Dr. Brown. Forty specimens were analyzed and the rationale for selecting these specimens is as follows.

There were only two obsidian artifacts from Ba'ati Ataro (chapter 4) so pieces from these flakes were included in the analysis. By contrast many of the levels of Danei Kawlos have been sampled as this was the site with abundant obsidian artifacts. Samples were taken from each 5 cm level of Danei Kawlos in order to see possible (if any) changes of raw material sources through time. However, four samples from a single level (80-85cm below surface) of this site were also taken to see if there were different raw material sources at a "specific" time (I chose this level because it contained a few quartz artifacts). Two samples from surface scatters of EjJu8, spatially located between Ba'ati Ataro and Danei Kawlos, were also included to see if there was a raw material source variability across space.

The methods and full results of trace element analysis are presented in Appendix A. However, based on iron content, two principal sources for Danei Kawlos are

identified. Interestingly the obsidian of the sites of Ba'ati Ataro and EjJu8 apparently belong to a third type of source. The implications of this for regional interaction are discussed in chapter seven.

Composition of the Lithic Industry

Although unmodified waste dominates the lithic assemblage at Danei Kawlos, the site also yielded shaped tools including scrapers of different forms and microliths (Table 3.1). Shaped tools are limited to layers 5, 4, and 3, while layers 2 and 1 are devoid of any formally shaped lithic artifacts.

Unmodified waste (n=1063)

Unmodified waste which includes debris such as angular waste (n=178, mean weight 4g), whole flakes (n=539, mean weight 3g), blades (n=72, mean weight 2g), broken flakes (n=218, mean weight 2g), cores(n=9, mean weight 21g), and split pebbles (n=45, mean weight 13g) constitutes 91% of the total lithic assemblage recovered from the site. The highest proportion of these comes from stratigraphic layer 5 which comprises 65% of the angular waste, 76% of the broken flakes, and 67% of the cores. Layer 5 also contains almost all the "retouch or tool trimming debris" that amounts to 928 pieces (including at

least two burin spalls) weighing 163g. The high proportion of debitage in layer 5 indicates that artifacts were manufactured, or at least shaped, at the site throughout the time represented. However, tool manufacture at the site must have ceased (at least in the area excavated) as only insignificant amount of debris is found in the higher layers.

Angular waste, broken flakes, and "tool trimming debris" diminish in frequency in the higher layers. Also interesting is the raw material distribution. Thus, much like shaped tools (see below) the angular waste and incomplete flakes were from chert and obsidian at layers 5 and 4 but are replaced by basalt and quartz at layers 2 and 1. The tool trimming debris from layer 5 are also from chert, obsidian, and chalcedony, amounting to 58%, 40%, and 2% of this class respectively.

Cores are restricted to stratigraphic layers 5, 4 and 3, which contain six, two, and one cores respectively. Three types of cores are recognized: prismatic/pyramidal cores, single platform cores, and multiple platform cores. The former are restricted to layer 5 only, while a single multiple platform core comes from layer 3. Three of the cores are obsidian while the rest are chert. The cores in

layer 5 show distinct platform preparation and are effectively exhausted.

Table 4.1 Inventory of Lithic Artifacts from Danei Kawlos

Artifact type	Stratigraphic Layer					Total
	One	Two	Three	Four	Five	
SCRAPERS						
single end scraper				2	1	3
single side scraper			1		2	3
end and side scraper					1	1
double side and end scraper					4	4
triangular steep scraper					1	1
circular scraper				1		1
notched scraper				3	2	5
undifferentiated scraper				1	1	2
scraper fragment				1	1	2
TOTAL SCRAPERS			1	7	13	22(2%)
MICROLITHS						
crescent				1	8	9
curved backed			2	1	9	12
straight backed					4	4
miscellaneous backed				1	7	8
backed fragment			2	3	25	30
orthagonal truncation				1	1	2
oblique truncation				1	1	2
double backed					1	1
TOTAL MICROLITHS			4	8	56	68(6%)
OTHER SHAPED TOOLS						
burin				1	5	6
bec					1	1
outilles escailles					2	2
scraper bec					1	1
TOTAL OTHER				2	9	10(1%)
UNMODIFIED WASTE						
whole flake	13	16	21	52	437	539
broken flake	9	8	10	26	165	218
blade	1	3	6	4	58	72
bipolar flake				1		1
flake talon fragment					1	1
prismatic core					2	2
single platform core				1	2	3
multiple platform core			1	1	2	4
angular waste	23	15	11	11	118	178
other (e.g., split pebbles)	12	9	1	5	18	45
TOTAL UNMODIFIED	58	51	49	100	803	1063(91%)
GRAND TOTAL	58	51	55	118	881	1163

Table 3.2 Raw Material Distribution by Stratigraphic Layers at Danei Kawlos

Raw Material	Stratigraphic Layer					Total	Percent
	One	Two	Three	Four	Five		
Chert	15	21	40	87	658	821	70.59
Obsidian	3	1	6	13	146	169	14.53
Basalt	27	12	6	4	6	55	4.73
Quartz	12	14	3	7	11	47	4.04
Chalcedony		3		4	40	47	4.04
Sandstone				3	18	21	1.81
Agate	1				1	2	0.17
Indeterminate					1	1	0.09
TOTAL	58	51	55	118	881	1163	100%

Table 3.3 Chert Variability at Danei Kawlos

Color	N. of artifacts	Percentage
black chert	204	24.9
dark brown chert	178	21.7
light brown chert	156	19.0
tan chert	114	13.9
gray chert	88	10.7
yellow chert	50	6.1
white chert	14	1.7
olive chert	11	1.3
red chert	6	0.7
Total	821	100

Whole flakes (n=539, Figs 3.4-3.10)

Whole flakes are found in all the stratigraphic layers, but the majority (81%) are confined to stratigraphic layer 5, although this could be due to the

thickness of the layer (Fig. 3.2). The mean length, width, and thickness of whole flakes of all the layers is 21, 18, and 5 mm respectively. However, these mean values fluctuate slightly throughout the stratigraphic layers (Figs. 3.4-3.6).

Figures 3.8 to 3.10 show some characteristics of whole flakes. End struck flakes predominate the flake assemblages. Although many flakes have irregular or undetermined cross sections some have lenticular and triangular cross sections (Fig. 3.8). Most flakes have a plain striking platform (Fig. 3.9); but some have simple/multiple faceted platforms that may indicate core preparation. Over 60% of the flakes, including nearly all of the obsidian flakes are edge damaged. This may be due to either the intentional use of these artifacts or depositional and/or post depositional factors. Future microwear analysis (Shea 1992) and perhaps also DNA analysis (Kimura et al. 2001) may contribute to our understanding of the functions of these artifacts.

By far the most frequently utilized raw material for flakes is chert, constituting nearly 79%, and followed by obsidian with 12%. However, there were major changes in the frequency of flakes in terms of raw material variability across the stratigraphic layers. Thus, while

chert is the dominant raw material in layer 5, it progressively decreases through time and is finally replaced by basalt as the dominant raw material in layers 2 and 1. Almost all of the obsidian flakes (60 of the 64 flakes) are confined to the lowest layer (layer 5). Thus the lowest layer is composed of almost entirely of chert and obsidian; there is only one basalt flake in this layer, a situation that is also prevalent in Layer 4. Basalt becomes common in layer 2 and constitutes more than half of the whole flakes in stratigraphic layer 1.

Shaped Tools

Danei Kawlos yielded a total of 100 shaped tools (Figs. 3.11-3.23), comprising about 10% of the total lithic assemblage. Most of the shaped tools (78%) are from layer 5, while layers 4 and 3 respectively contain 17 and 5% of the total shaped tools. Layer 3 had only two curved backed pieces, one scraper, and two broken backed pieces, indicating the decrease of shaped tools in this layer. The top two layers (layers 1 and 2) encompass no shaped tools. It is also noteworthy that layer 5 contains the only two outilles escailles pieces and all the composite tools as well as five of the six burins of the site.

Table 3.4 Shaped Tools by Raw Material at Danei Kawlos

Artifact Type	Raw Material				Total
	Obsidian	Chert	Chalcedony	Quartz	
SCRAPERS					
single end scraper	1	2			3
single side scraper		3			3
end and side scraper	1				1
double side and end scraper	1	2		1	4
triangular steep scraper		1			1
circular scraper		1			1
notched scraper	2	3			5
undifferentiated scraper		2			2
scraper fragment		2			2
MICROLITHS					
crescent	4	4	1		9
curved backed	7	2	3		12
straight backed	4				4
miscellaneous backed	6	2			8
backed fragment	23	6	1		30
orthagonal truncation	1	1			2
oblique truncation		2			2
double backed	1				1
OTHER SHAPED TOOLS					
burin	4	2			6
bec	1				1
outiles ecailles	2				2
scraper bec		1			1
TOTAL	58	36	5	1	100

Scrapers (Figs.3.11-3.18)

Scrapers form 19% of the total shaped tools. The majority of the scrapers were on chert while there were five obsidian scrapers and one quartz scraper. Chert is present in all layers while obsidian is limited to layers

5 and 4; and the only quartz scraper of the site comes from the lowest layer, layer 5. Indeed most of the scrapers are concentrated on layer 5, but decrease in number steadily higher in the stratigraphy with layer 4 containing six of them and layer 3 containing only one.

The mean length, width, and thickness of all the scrapers is 34 mm (range 17-60, sd=11), 29 mm (range 11-45, sd=11), and 10 mm (range 3-25, sd=6) respectively. While the mean length and thickness of all the layers are close to the general average, the mean width steadily decreases over time across the stratigraphic layers (Figs. 3.11-3.13).

The cross section of the scrapers also varies. Indeterminate cross section is the most dominant type, but triangular or subtriangular and parallelogram cross sections are also prevalent. Other cross sections present include lenticular and plano-convex types (Fig. 3.15).

Many scrapers have unifacial-obverse (dorsal) retouch but the location of the retouched varies widely (Table 3.7). The retouch type is almost exclusively simple or stepped. Except for the scraper fragments whose blanks could not be determined, almost all of them were retouched on flake blanks.

According to Clark's (1973) classification, if the retouch angle is <25° it is shallow, 25-60° is blunt, and >60° is steep retouch irrespective of the retouch being a plano- or bi-clinal edge. The mean retouch angle at Danei Kawlos is 57° (standard deviation is 6°) with a range between 35° and 85°, borderline between retouch and backing. Thus, the scrapers at Danei Kawlos fall in the range of blunt and steep retouch, there is no shallow retouch at Danei Kawlos. Such steep angles can be indicators of repeated use of the scrapers but further research is needed to verify this.

End scrapers (n=3)

Two end scrapers come from layer 5 and one from layer 4. They are of obsidian and chert, and have irregular or triangular cross sections. Marginal to semi-invasive retouch on the dorsal or ventral surface characterizes these scrapers. Retouch is simple or stepped, and located on distal or proximal sides. The mean length, width, and thickness of end scrapers is 12 mm (range 27-50, sd=12), 24 mm (range 11-36, sd=13), and 10 mm (range 5-18, sd=7) respectively.

Single side and end scrapers (n=3)

These are made only from chert and come from layers 5 and 3 of the site, all marginally retouched on the ventral or dorsal surfaces. Retouch is simple. Mean length, width, and thickness is respectively 40 mm (range 27-60, sd=18), 31 mm (range 22-38, sd=8), and 8 mm (range 5-11, sd=3).

Double side and end scraper (n=4)

These come from layer 5 only. One is on obsidian, two on chert, and one on quartz, the only shaped tool of such a raw material from the site. They are largely triangular or sub-triangular in cross section. Retouch is marginal to semi-invasive, on the dorsal face although one shows parti-biclinal. Retouch is either simple or stepped. The mean length is 29 mm (range 21-39, sd=8), mean width is 30 mm (range 15-42, sd=11), and mean thickness is 11 mm (range 5-22, sd=8).

Notched scrapers (n=5)

Coming from layers 5 and 4, these mostly steep notches are made on non-cortical obsidian and chert. They show variability in cross section but retouch is always on the ventral face. The mean length, width, and thickness is 37 mm (range 28-41, sd=7), 23 mm (range 15-39, sd=14), and 7 mm (range 3-12, sd=5).

Table 3.5 Scraper Retouch Direction and Location from Danei Kawlos

Retouch direction and location	No. of scrapers
dorsal, distal end	2
dorsal, distal and right lateral edge	1
dorsal, distal and both lateral edges	4
dorsal, circular	1
dorsal, proximal and both lateral edges	1
dorsal, indeterminate	1
ventral, right lateral edge	4
ventral, proximal end	1
ventral, left lateral edge	1
biclinal, distal and right lateral edge	1
biclinal, distal and both laterals	1
Indeterminate	3
TOTAL	21

Other scrapers

One of each of the following scrapers were also found at Danei Kawlos: an end and side (chert) scraper from layer 5; a steep triangular (or convergent?) scraper of obsidian from layer 5; and a circular chert scraper from layer 4. Danei Kawlos also yielded two undifferentiated scrapers and two scraper fragments: one of each from stratigraphic layers of 5 and 4.

Microliths (Figs. 3.19-3.23)

There are 38 whole and 30 broken backed tools. The following general description, however, is based on the complete backed tools. The most prevalent type of backing is inverse backing. Other types of backing in decreasing order include bidirectional, obverse, and alternating (Fig. 3.19).

None of the backed implements displays cortex. The most frequently used raw material for backed microliths is obsidian, but there are chert and chalcedony microliths as well. While obsidian and chert were employed to make other shaped tools, it is interesting to note that there are no other shaped artifacts made of chalcedony.

The backed tools consist of crescents, curved backed, straight backed, truncations, that like scrapers and other shaped tools, are concentrated in layers 5 to 3. Of the total whole backed tools 31 of them are from layer 5, while five of them come from layer 4 and two backed pieces from layer 3.

Crescents (n=9)

Crescents at Danei Kawlos account for 24% of the complete microliths. They are made of obsidian, chert and chalcedony. They are characteristically thin, the maximum thickness being only 3 mm. The mean length and width is 17 mm (range 14-22, sd=3) and 6 mm (range 5-9, sd=1). Each of them also weighed a gram or less. Almost all of the crescents are from layer 5, with only one from layer 4. Most have either inverse or bi-directional backing; only one has obverse backing.

Curved backed (n=12)

Curved backed microliths account for 32% of the complete backed tools of the site, and are distributed in layers 5 to 3 although nine of the twelve are in layer 5. Most are made of obsidian, while two are from chert and three are from chalcedony. While obsidian curved backed microliths are distributed in layers 5-3, chalcedony pieces are limited to layer 5. The mean length, width, and thickness is 20 mm (range 11-28, sd=5), 8 mm (range 4-13, sd=3), and 3 mm (range 2-8, sd=2) respectively. Maximum weight is 2g.

Straight backed (n=4)

All are from obsidian and confined to the bottom layer, layer 5. They all have inverse backing. The mean length, width, thickness is 16 mm (range 12-19, sd=3), 6 mm (range 3-7, sd=2), and 2 mm (range 1-2, sd=0.5) respectively, while each weighs a gram or less.

Double backed (n=1)

There was only one double backed microlith, which came from layer 5 of the site. It is from obsidian and measures 21 mm in length, 10 mm in width, and 3 mm in

thickness. It is from obsidian and has a trapezoidal cross section.

Truncations (n=4)

There are two oblique and two orthagonal truncations, one of each found at layers 5 and 4. Each truncation had one of the following backing types: obverse, inverse, bidirectional, and alternating. Two of them are backed on their distal end and the rest are backed on either the proximal or medial/distal side. Only two types of raw materials were used for truncations: chert and obsidian. The mean length, width, and thickness is 16 mm (range 13-23, sd=5), 12 mm (range 7-14, sd=3), and 3 mm (range 2-3, sd=0.5). Each weighs a gram or less.

Miscellaneous backed (n=8)

Seven of these pieces come from layer 5, and only one from layer 4. They disappear higher in the excavated sequence, as do other tools. Six of them are from obsidian (all at layer 5), and the rest are chert. The mean length, width, and thickness of the total pieces is respectively 15 mm (range 11-20, sd=3), 11 mm (range 6-23, sd=5), and 3 mm (range 2-5, sd=1). The maximum weight is 3g. Although most of them were backed along the proximal end, others were backed at the medial side or distal/medial side.

Broken microliths (n=30)

These form the single largest group of "shaped tools". While some of them could not be determined from which specific class of microliths they were broken, others were definitely broken from straight or curved (and perhaps crescentic) microliths. Of particular interest are the broken pieces which look like one-half trapeziums or what Clark (1973) calls shouldered pieces which were always found snapped in one half (no whole specimen has been found, Fig. 3.22). The difference here is that while the shouldered pieces were retouched on their proximal and distal side only (see figures in Clark 1973:100) these specimens seem to have been backed on the whole side. Whether these were broken during manufacture, during or after use, or because of post depositional factors remains unknown. Future microwear analysis could shed some light on this.

Burins (n=6)

Burins comprise 6% of the total shaped tools. They are present in layers 5 and 4 only. While there are five burins in the former layer, the latter layer contains only

one burin. At least two burin spalls are also present in layer 5.

Miscellaneous Shaped Tools

Danei Kawlos also yielded some tools that could not be placed in the foregoing tool classes (Fig. 3.23). These include a bec (obsidian at layer five); two outille escailles (obsidian, layer 5); and a composite tool, a scraper bec (chert, layer 5).

Ceramics (Figs. 3.24-3.29)

A total of 224 potsherds were found at Danei Kawlos. Figure 3.24 shows the distribution of ceramics across the levels of the site. The sherds are composed of 19 (8%) rims, 2 bases, and 203 body sherds. Most sherds in stratigraphic layer 5 were either burnished, slipped, or both. The mean wall thickness of rims and body sherds is 7 mm. The bases have a slightly higher mean, 10 mm. The mean values for the wall thickness of all body sherds across stratigraphic units is presented in Figure 3.25.

The sherds vary in color. However, of particular interest are black and dark gray sherds that are confined to the two upper layers while the red to light brown sherds are largely restricted to stratigraphic layer 5.

Red and yellow-orange plain and decorated pottery are almost entirely restricted to layer five. Many of the sherds are extremely hard; fragmented rock inclusions (or temper) are common. Quartz inclusions are rare at the bottom layer but increase in frequency throughout the higher layers. Otherwise the pottery is homogeneous at layers five and four, but changes in color and other aspects are evident beginning at layer three: the pottery is rarely, if ever burnished, and it also becomes coarser; at the same time sherds show some sooting, probably a result of cooking.

I did not make any attempt at gleaning any information about rim diameter as the rims were too small to be of any utility. In fact the potsherds were too fragmented and their perimeter/margins so worn that except in four cases, refitting of pieces was not possible. This fact also made it impossible to derive any information on the techniques of manufacture. The only exception to this is one "refitted" sherd from three pieces whose breakage pattern unmistakably shows coil manufacture. The fact that refitting was not possible also precluded any attempt to reconstruct vessel shapes.

Ninety one (or 41%) of the sherds were decorated. All the stratigraphic layers except layer 1 contained

decorated sherds. Thus layer two had seven, layer three contained two, layer four encompassed 10, and layer five comprised 70 of the decorated sherds.

Four decorative techniques are prevalent: incision, rocker- and check-stamping; and only one case of cord stamping. By far the most common decorative technique is incision to create a closely spaced parallel straight or zigzag lines or both motifs. This must have been done by a two or multiple pronged instrument as can be seen from the spaces between the deep incised lines (Figs. 3.27b, 3.28b).

Incision was also employed in conjunction with another favored technique, rocker stamping, to create a variety of motifs. These include a mat pattern, and packed or scattered dots and/or squares. Incision and/or rocker stamping were also employed to decorate rims with a herringbone, mat, or cross-hatching motifs.

Decoration showed variability across stratigraphic layers. Layer 5 contained all three types of decoration, but layer 4 contains almost exclusively incised pottery and a few rocker stamped ones. Decoration at layer 3 and 2 was rudimentary or nominal, with no rocker stamping or deep incision. There are no decorated sherds at layer one.

Faunal Remains

In addition to the cultural materials discussed above, Danei Kawlos also yielded faunal remains. As mentioned above, the use of a 1-mm-mesh screen allowed the recovery of small animal remains from the site, that indeed make up the largest category of the faunal assemblage. The following is a presentation of the identifiable faunal specimens based upon the report kindly provided by Dr. F. Marshall. A more detailed account is provided in Appendix B.

Stratigraphic Layer 5

One hundred seventy nine specimens were identified to the level of a tribe or genus from this stratigraphic layer. Rodents (80%) dominate the faunal assemblage but mollusks (6%), hyrax (5%), hare (2%), and wild suids (2%) are also present. Four domestic cattle specimens and one possible caprine specimen (constituting 2 and 0.5% of the faunal assemblage from this layer) are also identified. One human tooth, one primate radius, and one fish specimen are also represented.

Stratigraphic Layer 4

Forty of the 49 specimens (82%) identified at this layer are rodents. However there are four hyrax, two cattle, and one of hare and caprine specimens as well respectively constituting 8%, 4% and 2% of the identified fauna.

Stratigraphic Layer 3

Although there are only 14 specimens identifiable at this layer, as in the lower layers rodents still dominate the assemblage. Nine rodent specimens are identified, while cattle and caprines are represented by one specimen each. Three specimens of reptiles appear for the first time at this layer.

Stratigraphic Layer 2

Of the nine identifiable specimens four are rodents, one reptile, two cattle and one caprine, as well as one hyrax.

Stratigraphic Layer 1

Five rodents were recovered from this layer. But there are also three cattle specimens, one caprine bone, and one hyrax.

Soil Samples

Robertshaw and Collett (1983) argue that the absence of flotation techniques are responsible for the absence of seed recovery in eastern African Archaeology. While this is sadly true of most early investigations, recent fieldwork in the Atbai region of eastern Sudan (D'Andrea and Tsubakisaka 1990) and at Aksumite sites in and around the city of Aksum (Bard and Fattovich 1995; Phillipson 1996) has demonstrated the possibility of recovering charred plant remains. Therefore, I emphasized systematic flotation of floor samples (Pearsall 1989; Struever 1968; Wagner 1988). This was conducted at the National Museums of Ethiopia. Floated samples have been submitted to Dr. D'Andrea at Simon Frazer University. Unfortunately, however, although analysis is still underway, no seeds have been recovered from the samples already investigated.

Soil samples have also been submitted to Dr. Mohammed Omar of Addis Ababa University for palynological analysis. The analyses of these are also being awaited.

Summary History of Danei Kawlos

The fact that the site contains cultural materials and ecofacts to bedrock indicates that Danei-Kawlos'

ca.140 cm were deposited after an initial occupation on a bedrock surface. Unlike Ba'ati Ataro (Chapter 4) Danei Kawlos yielded no grinding stones. There were no hammer stones either, although basalt cobbles which can be used as hammer stones are abundant in the vicinity of the site.

Other aspects of the lithic sequence of Danei Kawlos showed some interesting trends. First, there is a steady decrease and final disappearance of shaped tools. Shaped tools begin from the earliest occupation of the cave in abundance up to stratigraphic layer 3. Second, there is change in focus of raw material from those which have an excellent conchoidal fracture (chert and obsidian), to locally available raw materials, basalt and quartz. This change also appears in layer three. Layer three contains few shaped tools but the two layers above it do not contain any; at the same time those two layers are dominated by basalt and quartz raw materials.

This change is also reflected in the ceramic sequence of the site. The ceramic complex in the earliest deposits of the site are burnished and/or slipped fine wares with body and rim decoration and thin walls. In layer 3, however, a coarse ware appears with little or no decoration; when decoration appears it is in the form of simple incisions. Burnishing and slipping are absent and

inclusions tend to be largely quartz. As with lithics, this pronounced shift in frequencies occurs at stratigraphic layer 3. Therefore, the potsherds of Danei Kawlos show at least two different ceramic assemblages with the earliest occurring in the lower parts of the cave (layers 5 and 4) and the latter occurring mainly in layers 2 and 1.

Together, the ceramic and lithic assemblages of Danei Kawlos indicate that the cave was occupied successively by people of two different cultures or a single group whose material requirements and technology changed through time. The earliest inhabitants of the cave are represented by layers 5 and 4 that are characterized by a microlithic and scraper lithic assemblage in combination with rare burins and pieces escailles as well as incised, check- and rocker-stamped pottery. The succeeding inhabitants in layers 2 and 1 seem to have been dependent on flake technology with no formally shaped tools and plain coarse wares. This was also manifested in shift in raw material utilization. Thus, the inhabitants of the site represented by stratigraphic layers 5 and 4 were dependent on the use of obsidian, chert, and chalcedony, while there was a change to an almost exclusive dependence on basalt and quartz artifacts by layer 2 and 1 times.

There seems to be at least two explanations for this change in lithic and ceramic assemblage: one is due to changes in the function of the lithic and ceramic artifacts as a result of changes in adaptation or activities carried out at the cave, and the second is that such changes represent two distinct cultural groups. Further investigation is necessary before this can be settled. What can be said here, however, is that unlike Ba'ati Ataro (chapter 4) the changes here seem to have been gradual as is represented by layer 3 which shows a mixture of the artifacts that were present at the lower layers and the beginning of a new one that was to become common later.

Although rodents are sometimes considered to disturb a site the lithic and ceramic sequence show no such disturbance. At least the rest of the faunal assemblage "was accumulated prehistorically by humans during the course of butchery, cooking, consumption, and discard of animal food at the rock shelter" (Marshall pers. com.). It is therefore interesting that although domestic stock appear from the earliest layers of the site, they do not become abundant although because the sample size decreases in the upper layers the proportion of these becomes larger. Therefore there does not seem to be a major change

in the subsistence among the inhabitants of the cave. They depended on the exploitation of wild as well as domestic animals for their subsistence throughout the occupation of the site (Appendix B).

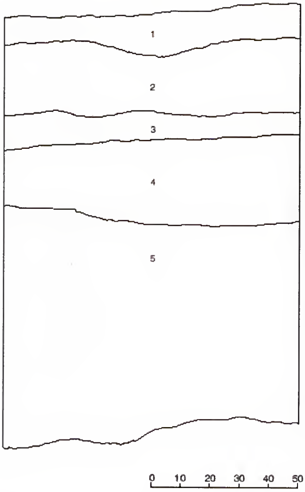


Fig. 3.2 Profile of the Eastern Wall of Danei Kawlos, TU3

Legend:
1. strong brown (7.5 YR 4/6) loose coarse sand
2. reddish yellow (7.5 YR 6/8) grainy sand
3. yellowish red (5 YR 4/6) sand
4. red (2.5 YR 5/6) silty sand
5. consolidated light reddish brown (5 YR 4/6) sand

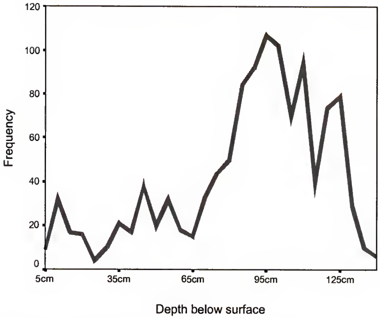


Fig. 3.3 Lithic Artifact Frequency at Danei Kawlos

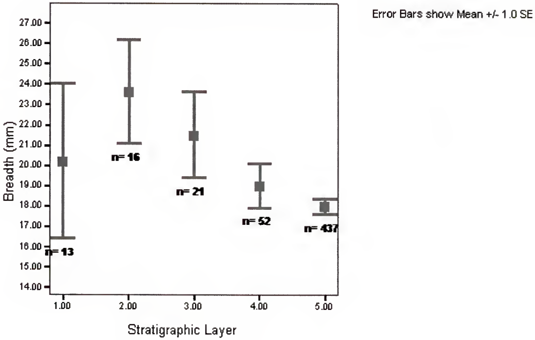


Fig. 3.4 Mean Breadth of Danei Kawlos Flakes by Stratigraphic Layer

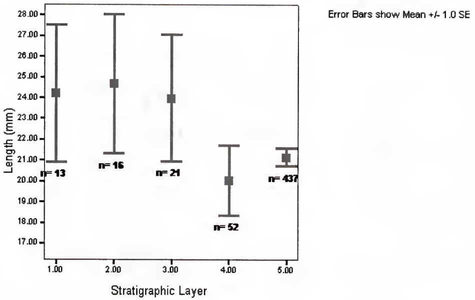


Fig. 3.5 Mean Length of Danei Kawlos Flakes by Stratigraphic Layer

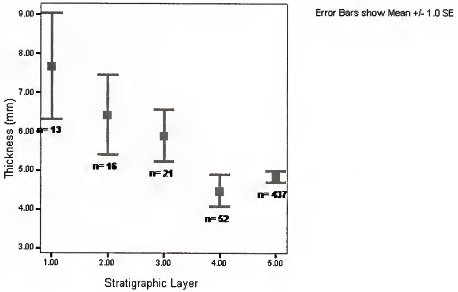


Fig. 3.6 Mean Thickness of Danei Kawlos Flakes by Stratigraphic Layer

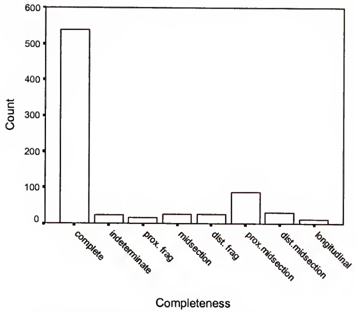


Fig. 3.7 Flake Completeness at Danei Kawlos

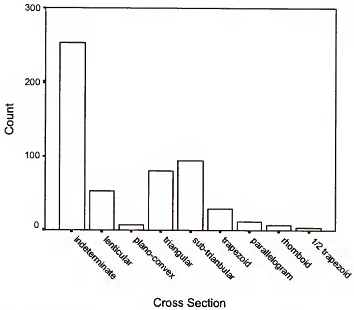


Fig. 3.8 Cross Section of Whole Flakes from Danei Kawlos

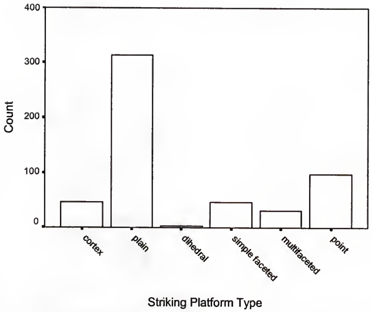


Fig. 3.9 Striking Platform Type of Flakes from Danei Kawlos

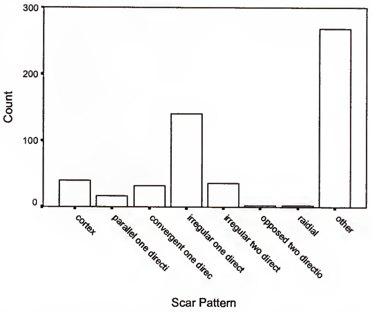


Fig. 3.10 Dorsal Scar Pattern of Flakes from Danei Kawlos

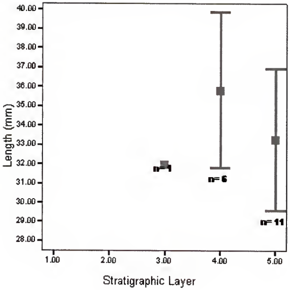


Fig. 3.11 Mean Length of Danei Kawlos Scrapers by Stratigraphic Layer

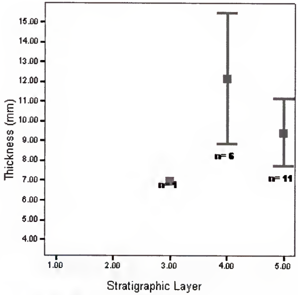


Fig. 3.12 Mean Thickness of Danei Kawlos Scrapers by Stratigraphic Layer

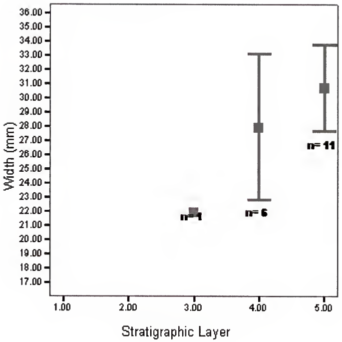


Fig. 3.13 Mean Width of Danei Kawlos Scrapers by Stratigraphic Layer

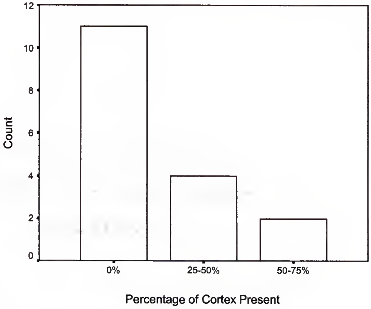


Fig. 3.14 Danei Kawlos Scrapers by Cortex

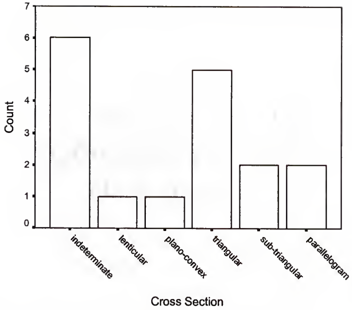


Fig. 3.15 Cross Section of Danei Kawlos Scrapers

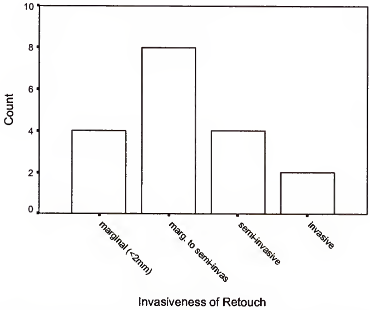


Fig. 3.16 Invasiveness of Retouch of Danei Kawlos Scrapers

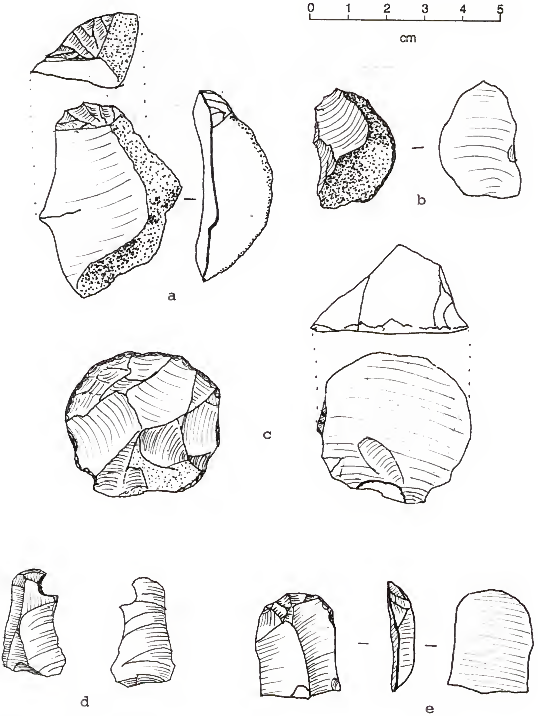


Fig. 3.17 Scrapers from Danei Kawlos: a.layer 4, end scraper, chert; b. layer 3, side scraper, chert; c. layer 4, circular scraper, obsidian; d. layer 4, notch, obsidian; and e. layer 4, end scraper, obsidian.

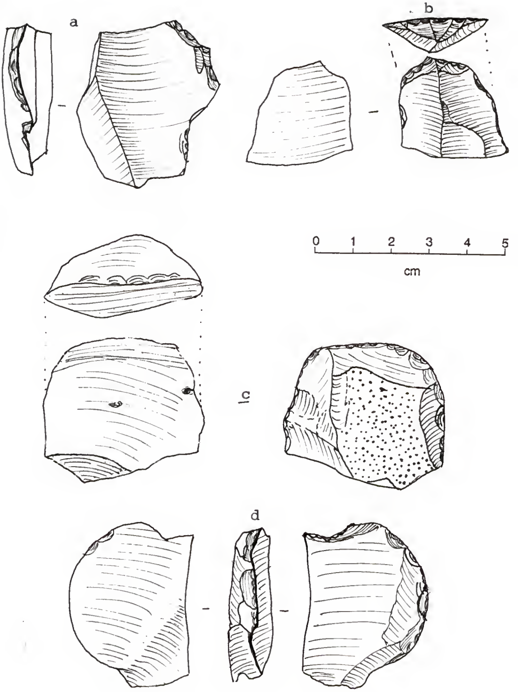


Fig. 3.18 Scrapers from layer 5 of Danei Kawlos: a. undifferentiated scraper, chert; b. double side and end scraper, obsidian; c. double side and end scraper, chert; d. notched scraper, obsidian.

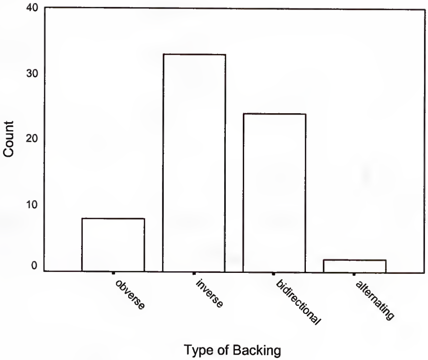


Fig. 3.19 Type of Backing of Danei Kawlos Microliths

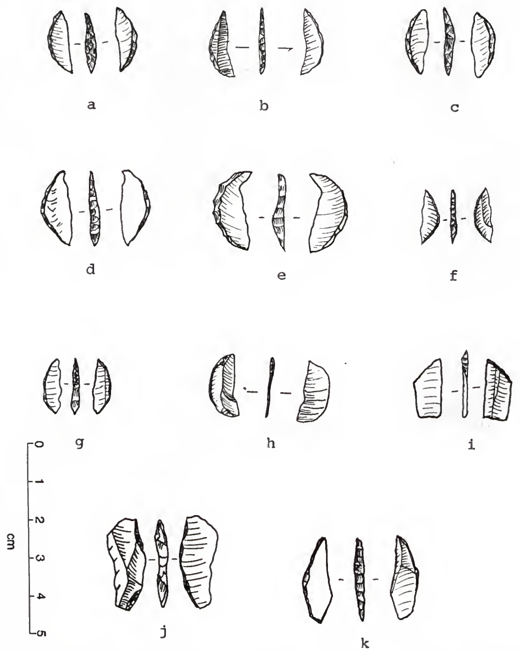


Fig. 3.20 Microliths from Danei Kawlos (a-i, layer 5; j-layer 4); a,b,g,h, crescent, chert; c,f,. crescent obsidian; e,j,k, curved backed, obsidian; d. crescent, chalcedony; .i, oblique truncation, chert.

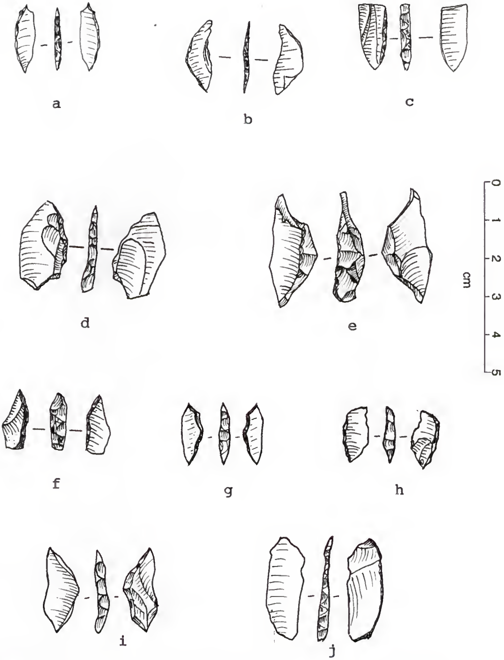


Fig. 3.21 Microliths from layer 5 of Danei Kawlos; a. curved backed, chert; b. curved backed chalcedony; c. straight backed, obsidian, d,e,f,h, miscellaneous backed, obsidian; g. miscellaneous backed, chalcedony; .i,j, curved backed obsidian.

Fig. 3.22 Broken Microliths from Danei Kawlos.

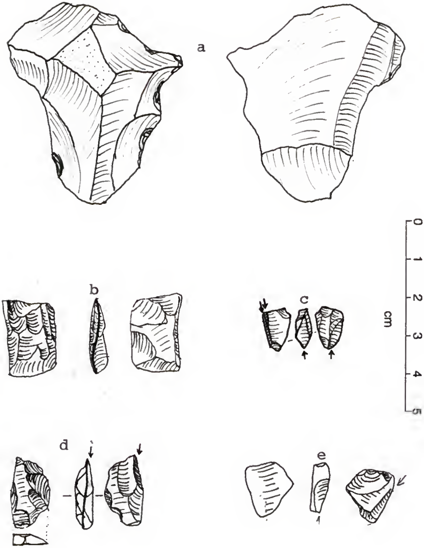


Fig. 3.23 Other Shaped Tools from Danei Kawlos (layer 5); a. scraper bec, chert; b. outil ecaille, obsidian; c-e, burins, obsidian.

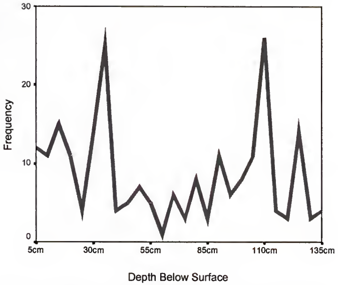


Fig. 3.24 Pottery Frequency by Depth at Danei Kawlos

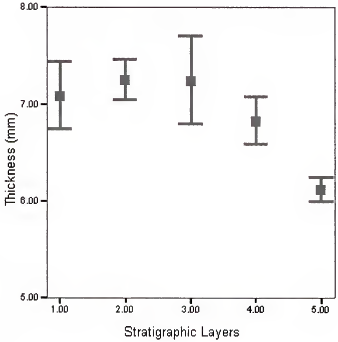


Fig. 3.25 Mean Wall Thickness of Body Sherds from Danei Kawlos

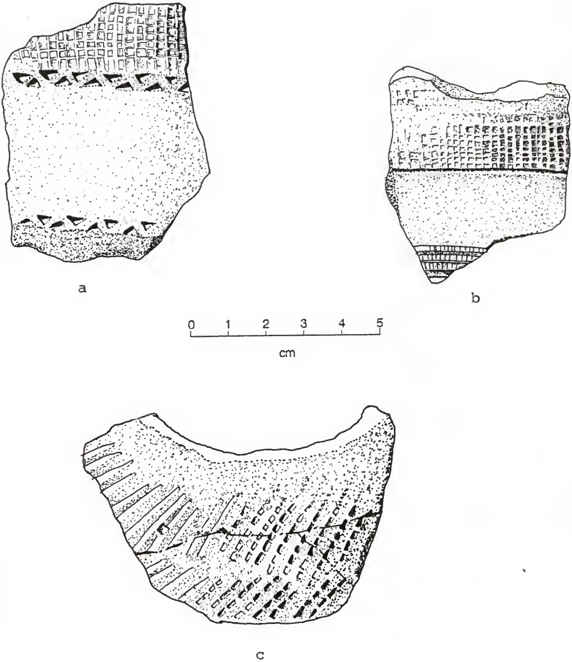


Fig. 3.26 Potsherds from Danei Kawlos

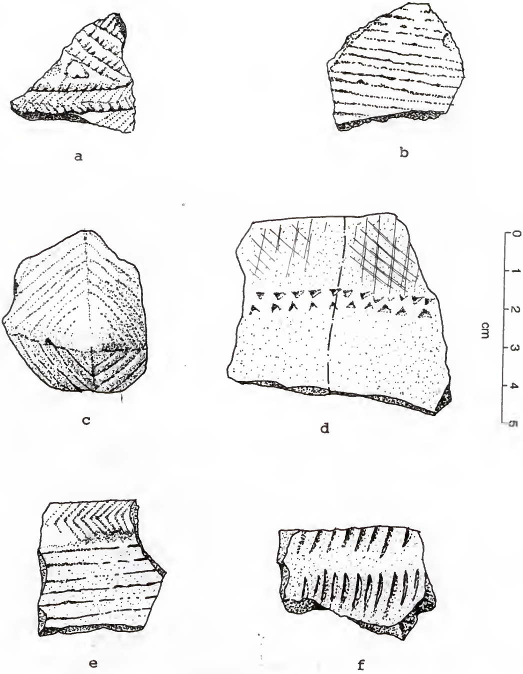


Fig. 3.27 Potsherds from Danei Kawlos

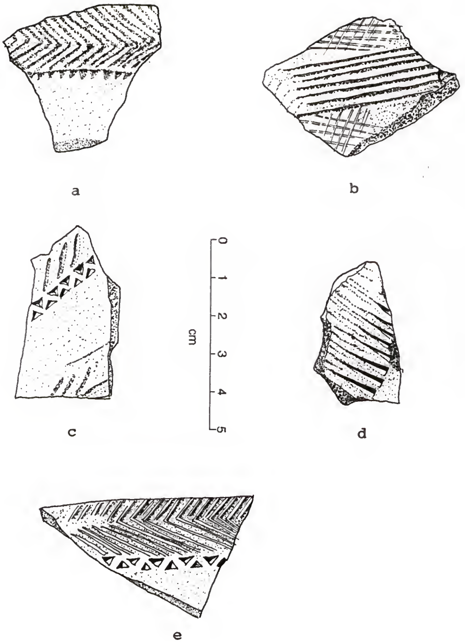


Fig. 3.28 Potsherds from Danei Kawlos

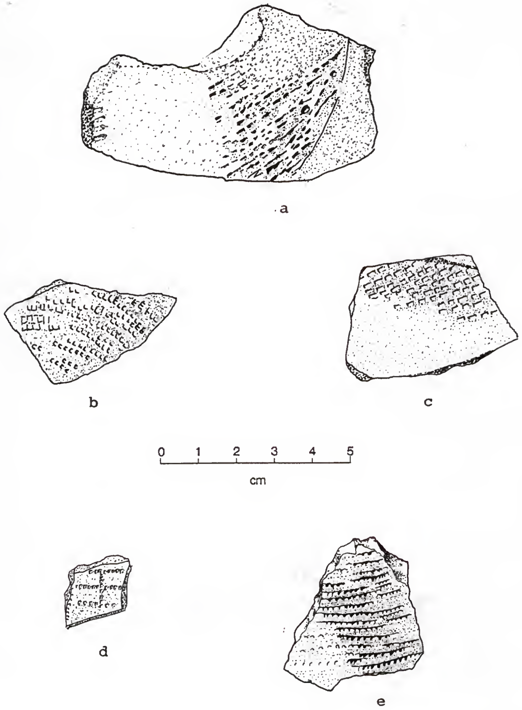


Fig. 3.29 Potsherds from Danei Kawlos

CHAPTER 4
THE SITE OF BA'ATI ATARO (EjJu37)

Ba'ati Ataro is a large cave situated ca.6 km north of Abiy Adi (Fig. 1.2). The site has a flat dirt floor and measures 25 m in length, 12m in depth, and a height of 6 m or thereabouts. It faces west and lies at the entrance to a box canyon with a view of a large plain to the south. At the mouth of the cave is a low rock wall that has been constructed by shepherds who still use the cave for animal shelter during the rainy seasons. On the plains in front of the cave are dense and defuse scatters of flaked stone artifacts belonging to the MSA/LSA. This is in direct contrast, as we shall see, to the lithic artifacts recovered from the test excavations of the site. A few kilometers north and northwest of the cave, particularly beyond the river Chini (Fig. 1.2), are concentrations of boulders of quartz.

I initially put in a $1m^2$ test unit (TU1), but expanded it to a $4x1m^2$ (termed test excavation units 1-4) trench as the site proved to be deeply stratified (Figs. 4.1, and 4.2). Due to the limitations of time and logistics only one of the squares (TU1) was excavated to bedrock to ca. 260cm

below surface. Test units two, three, and four respectively were dug to a depth of 165, 100, and 50cm below surface (see chapter 3 for excavation procedures).

Lithostratigraphy, Dates, and Associated Artifacts

Ba'ati Ataro is just not only the deepest of all the excavated sites, but it also represents the most complex lithostratigraphy (Fig. 4.2). There are 24 artifact bearing stratigraphic layers of differing thicknesses. While many of them are conformably overlain by one another, some of them show obvious disconformities. The following is a brief description of lithological and associated cultural material recovered from the site, from the bedrock upwards.

The earliest layer of the site, layer 24, is composed of a dark red (2.5YR 3/6) sand and contains only lithic artifacts mostly composed of chert and chalcedony, although there are some quartz artfacts as well. It has variable thickness measuring between 10 to 25 millimeters, a result of the uneven nature of the bedrock.

Layer 24 is overlain by a dark yellowish brown (10YR 4/6) sandy loam that represents a break from layer 24 not only in terms of lithological composition but also in terms of cultural remains. Grinding stones and pottery appear at the site for the first time. There are two new lithic raw

materials (basalt and sandstone) that also appear for the first time at this layer. A fragmentary semi-lunar of a domestic Bos (identified by Dr. Marshall, see Appendix B) from this layer was submitted for direct radiocarbon dating. Unfortunately, however, the sample contained only 11.1 mg (1.71%) of collagen that was far below the acceptable range and dating it was a long shot. Indeed, it yielded an age of 994 ± 47 BP and has been rejected.

Layer 22, a dark reddish brown (5YR 3/6) sandy clay, contains an additional lithic raw material, a slate. Chert and chalcedony are less prevalent but basalt artifacts begin to be intentionally shaped. A lower molar fragment of a domestic Bos has been submitted for radiocarbon dating from this layer, but also lacked sufficient collagen. Unconformably overlaying this layer is a very dark brown (7.5YR 2.5/2) loam that contains more basalt shaped tools in addition to some heavy duty tools represented by a large quartz core scraper and a chopper. The density of artifacts is much lower in layer 19, a pale yellow (2.5Y 7/3) unconsolidated angular gravelly sediment interspersed with sand containing only basalt and quartz artifacts, chert and chalcedony being absent from the stratigraphy. This layer is about 20 cm thick but contains fewer lithic and ceramic artifacts. It is overlain by layers that contain a higher

frequency of potsherds. However potsherds begin to be scarce in layer 12, a yellowish brown (10YR 5/8) sandy soil interstratified with calcareous conglomerates containing less pottery which is separated from a thick layer 10 (2.5Y 8/4 coarse sand) by a thin black soil (10YR 2/1)--all of which contain few pot sherds.

Layer 8, composed of a black (10YR 2/1) loam, represents a distinct cultural break in that iron and obsidian appear for the first time at the site. The pottery, however, is similar to the previous layers, and does not show any major fabric change. Layer 8 is overlain by a number of other layers which have differing lithology but which contain similar potsherds. However, there seems to be a tendency throughout the higher layers for dependence on more chert artifacts. Of particular interest is layer 3, which a is a hard and compact dung matrix which has effectively sealed the site. Layers 2 and 1 have also some dung remains but are softer than the lower layer.

The Culture Stratigraphic Units (CSU)

As can be seen from the foregoing and Fig. 4.2, Ba'ati Ataro is a stratigraphically complex site. Therefore, because the main objective of this dissertation is to reconstruct the culture chronology of area, it is important

to group the data into temporally sensitive cultural units, referred to here as CSU's.

Thus on the basis of cultural remains alluded to previously and discussed in detail below, three major Culture Stratigraphic Units (CSU-I, CSU-II, and CSU-III) can be distinguished at Ba'ati Ataro. CSU-III is represented by only one stratigraphic layer. It is the only layer of the site that consists of an aceramic lithic industry. It is overlain by CSU-II, which is composed of a number of lithological strata (layers 23 to 9) containing artifacts that are different from CSU-III, both in terms of raw material and artifactual composition. It also contains additional technologies: pottery and grinding stones. The next major break in cultural material is represented by CSU-I, beginning in layer 8, where a new raw material -- obsidian -- appears together with an entirely new technology, iron.

The Cultural Materials

Lithic Artifacts

In spite of its depth, Ba'ati Ataro yielded only 468 lithic artifacts. A complete inventory of these artifacts is presented in Table 4.1 while Fig. 4.3 shows the density of lithic tools by depth. It is interesting to note that,

like pottery (see below), lithic artifact frequency is very low between ca.90-150 and 165-190cm below surface (Fig. 4.3). This occurs even though there were three test excavation units that reached 100cm below surface and two test units that were excavated to more than 160cm below surface.

Table 4.1 shows lithic artifacts including scrapers of different forms; backed tools, heavy duty tools, and other composite tools. This is also one of the only two sites that yielded grinding stone implements. The grinding stones at this site, comprising both upper and lower grinding stone implements, total 34 and indeed constitute 7.3% of the total lithic assemblage recovered from the site.

Raw Material

There is an interesting distribution of lithic raw material across the layers of Ba'ati Ataro (Table 4.2). The lithic raw materials that were found at this site are quartz, basalt, chert, chalcedony, sandstone, and slate. The chert from this site has varying colors (Table 4.3) while the sandstone artifacts are all lower grinding stones. Basalt and quartz are the most utilized raw materials for shaped tools at the site, forming 40 and 31% respectively (Table 4.4).

Some of the chert materials were heat treated. All (except for one angular waste) the heat treated artifacts were flakes. While there is one heat treated flake in CSU-III, there are three in CSU-II, and five in CSU-I.

Chert and chalcedony are the dominant raw materials in CSU-III. A new raw material, basalt, appears only at the bottom of CSU-II, i.e., together with the introduction of pottery and grinding stones to the site, and progressively becomes common throughout the sequence. Indeed basalt is the single most utilized raw material for shaped tools of the site (Table 4.4). Basalt is a locally available raw material found widely dispersed in the region even at the mouth of the cave. In fact the current stone walls that are constructed by shepherds at the entrance of the cave are all from basalt. Few chert nodules were observed on the dry beds of the rivers that pass close to the cave, while there is an abundant outcrop of quartz materials a few km northwest of the cave.

Only two obsidian artifacts were found at the site: both flakes from CSU-I. The virtual absence of obsidian at the site is intriguing as it is an abundant raw material at Danei Kawlos (see Chapter 3), located some 10km south of Ba'ati Ataro.

Table 4.1:- Inventory of Lithic Artifacts at Ba'ati Ataro

Scrapers	Culture Stratigraphic Unit One	Two	Three	Total
single end scraper	3	1		4
single side scraper	1	2		3
double side scraper	1			1
end and side scraper		2		2
double side and end scraper	2	1	1	4
triangular steep scraper		1		1
circular scraper	2	1		3
notches	2	4		6
undifferentiated scraper	1			1
light duty core scraper	3	1		4
scraper fragment		3		3
TOTAL SCRAPERS	15	16	1	32 (7%)
Backed Implements				
curved backed	2			2
miscellaneous backed	1	2		3
backed fragment		2		2
orthagonal truncation	1	2		3
oblique truncation	2	1		3
double backed		1		1
TOTAL BACKED	6	8		12 (3%)
Composite Tools				
scraper and notch		2		2
backed and scraper		3		3
TOOTAL COMPOSITE		5		5 (1%)
Heavy Duty Tools				
heavy duty core scraper		1		1
heavy duty chopper		1		1
grinding stones	6	28		34
TOTAL HEAVY DUTY	6	30		36 (8)

Table 4.1 continued

Unmodified Waste	Culture stratigraphic unit			Total
	One	Two	Three	
whole flake	63	64	24	151
broken flake	43	22	9	74
blade	2	2	2	6
core trimming flake	1			1
amorphos core	1	3		4
single platform core	10	10	1	21
double opposed plat. core		2		2
double adjacent plat. core	1	1		2
multiple platform core		2		2
bipolar		1		1
blade core			1	1
fire cracked rock	4			4
angular waste	54	36	9	99
other	8	5		13
TOTAL UNMODIFIED	187	148	46	381 (81%)
GRAND TOTAL	214	207	47	468 (100%)

Table4.2 Raw Material Distribution across the Culture Stratigraphic Units of Ba'ati Ataro

Raw Material	Culture stratigraphic units			Total	Percentage
	One	Two	Three		
Quartz	92	60	12	167	35.68
Basalt	64	73		137	29.27
Chert	47	55	25	127	27.14
Chalcedony	4	4	10	18	3.84
Sandstone		10		10	2.14
Limestone		3		3	0.64
Slate		2		2	0.43
Obsidian	2			2	0.43
Indeterminate	2			2	0.43
TOTAL	214	207	47	468	100

Table 4.3:- Chert variability at Ba'ati Ataro

Color	Count	Percentage
black	44	34.65
gray	36	28.34
brown	23	18.11
yellow	11	8.66
tan	9	7.09
red	3	2.36
olive	1	0.79
Total	127	100

Table 4.4 Shaped tools by raw material at Ba'ati Ataro (qua=quartz; bas=basalt; che=chert; sla=slate; chal=chalcedony)

	Raw Material						
Artifact type	Qua.	Bas.	San.	Che.	Sla.	Chal.	Total
SCRAPERS							
Single end scraper	1	1		2			4
single side scraper		2		1			3
double side scraper				1			1
single end and side scraper		2					2
double side and end scraper	2			2			4
triangular steep scraper	1						1
circular scraper	2	1					3
notches	1	4			1		6
undifferentiated scraper				1			1
core scraper	1			3			4
scraper fragment	2	1					3
TOTAL SCRAPERS	10	11			1		32
BACKED IMPLEMENTS							
curved backed	2						2
miscellaneous backed	1	2					3
backed fragment		1		1			2
orthagonal truncation		1		1		1	3
oblique truncation	2	1					3
double backed		1					1
TOTAL BACKED	5	6		2		1	14
OTHER TOOLS							
backed and scraper		3					3
scraper and notch		1			1		2
heavy duty chopper	1						1
heavy duty core scraper	1						1
grinding stone		25	9				34
TOTAL OTHER TOOS	2	5			1		8
Grand Total	17	46	9	12	2	1	87

Composition of the Lithic Industry

Unmodified waste

Unmodified waste, which includes debris such as angular waste (n=99, mean weight 9g), incomplete flakes (n=74, mean weight 4g), cores(n=33, mean weight 34g), fire cracked rock (n=4, mean weight 148g) and split and or intact pebbles (n=13, mean weight 17g) constitutes 80% of the total lithic assemblage recovered from the site.

Angular waste constitutes 26% of the total unmodified waste and comes from CSU-I and II, while firecracked rocks are restricted to CSU-I only. All CSU's contain broken flakes and cores, although CSU-III contains only a few of them.

Cores form 9% of the total waste. Seven types of cores are recognized: amorphous, single platform, double opposed, double adjacent, multiple platform, bipolar, and blade. Most of them (64%) are single platform cores. While CSU-III has the single blade core of the site and one other single platform core, the rest are distributed at CSU-I and CSU-II. Most of the cores do not show any evidence of core preparation and some contain residual cortex. The number of flake scars on some of them is also very few. There were also other pebbles which showed a "flake" or two removed;

however these were not classed as cores as there was no clear indication of negative flake scars on the pebbles, and they may have been discarded at first attempt. All of these indicate some form of expediency. This is not surprising as the most common utilized raw material for cores is quartz, a material that is locally available.

Whole flakes (Figs. 4.4-4.10)

Flakes are by far the most abundant single class of tools at Ba'ati Ataro, amounting to 151 (32% of the total assemblage, and 41% of the unmodified waste). Of these, 95 (or 63%) are tertiary flakes, while secondary and primary flakes amounted to 39 and 17 respectively. The mean length, width, and thickness of the whole flakes is 24 (sd=11), 20 (sd=10), and 7mm (sd=5mm) respectively while the average weight of each flake is 6gms. While CSU-III contains flakes with averages less than these metric values there was no marked deviation from these metrical data in the averages of CSU-I and II (Figs. 4.8-4.10).

Eight of the flakes were heat treated. Over half of the flakes had indeterminate cross sections, but 31 of them were triangular or sub-triangular in cross section (Fig. 4.5). The striking platforms of the flakes also showed some variability (Fig. 4.6). Thus, 56% of them had a plain

platform while the rest had a cortical, pointed or simple faceted platform (this pattern is fairly consistent across all the cultural stratigraphic units). There were only a few flakes with multi-faceted and dihedral platforms--platforms that are usually associated with core rejuvenation. However, cores are usually rejuvenated if the raw material is rare. In the case of Ba'ati Ataro most of the flakes are made up of basalt and quartz that are abundantly available raw materials. Thus there may not have been a need to rejuvenate a core of an abundant material at the site. This is perhaps why there was only one core trimming flake at the site. Furthermore the raw material is chert, and it appears at CSU-I, together with the appearance of iron at the site.

More than 80% of the flakes showed some form of edge damage. This is a general pattern in all the culture stratigraphic units. The difference is a matter of magnitude. Thus, this is consistent with the flakes at culture stratigraphic units two and one but more than 95% of the flakes at CSU-III were utilized and/or edge damaged. This can be a result of trampling or other depositional or post depositional factors but this does not leave out the possibility of the application of these artifacts for some specific purposes. Unfortunately, however, no microwear

analysis has been undertaken at the site but future research may shed some light on this.

Most of the flakes are end struck flakes. Some of the flakes had 100% cortical dorsal surfaces while there were different dorsal scar patterns. Among others, these included parallel or convergent one direction, opposed two directions, and irregular multiple directions. However, there were three flakes with radial dorsal scars evenly distributed across each culture stratigraphic unit.

Shaped Tools

Ba'ati Ataro yielded 52 shaped tools and 34 grinding stone implements (indeed there are only two sites that yielded grinding stones: Ba'ati Ataro and Dabo Zelelew with one ground stone implement). Shaped tools from this site include composite tools, backed pieces as well as scrapers, which are described in the following sections.

Scrapers (n=32, Figs. 4.11-1.18)

All three culture stratigraphic units contain scrapers. Two of these are found broken and will not be included in the following metrical discussion. While CSU-III contained only one scraper, CSU-I and II contained 15 and 13 each. The mean length, width, and thickness of all

scrapers is 34 (sd=12), 33 (sd=12), and 16 mm (sd=9 mm) (Figs. 4.11-4.13).

Table 4.5:- Retouch Direction and Location of Ba'ati Ataro Scrapers

Retouch Direction and Location	No. of Scrapers
Dorsal, right lateral	2
Dorsal, both lateral edges	1
Dorsal, distal end	1
Dorsal, distal and both lateral edges	3
Dorsal, circular	2
Dorsal, indeterminate	1
Ventral, both lateral edges	1
Ventral, distal end	3
Ventral, distal and right lateral edge	1
Ventral, distal and both lateral edges	1
Ventral, circular	1
Biclinal, left lateral	1
Biclinal, distal and both laterals	1
Part biclinal, left lateral	1
Part biclinal, right lateral	1
Part biclinal, distal and both laterals	1
Indeterminate	5
TOTAL	27

The mean retouch angle is 55° (range 25° to 80°; sd=15°). While many of them fall between 35 to 60°, which would make them blunt scrapers, others fall in the steep (>60°) and shallow (at 25°) retouch categories.

The scrapers are marginal to semi-invasively retouched. Retouch is almost exclusively simple and largely unifacial obverse (dorsal) but there were also others with unifacial inverse (ventral), part-biclinal, as well as few

biclinal retouches. Table 4.5 shows location and direction of retouch. Some other characteristics of the scrapers such as cross section, invasiveness of retouch, scraper blanks, and percentage of cortex on the dorsal faces are presented in Figures 4.14-4.17.

Single end scrapers (n=4)

These are limited to CSU-I and II. Each contains one and three single end scrapers respectively. There is variability in terms of raw material choice. The single end scraper from CSU-II is from basalt while those of CSU-I are from chert and quartz, which are slightly abraded. Only one of the scrapers is on a cortical flake. Retouch type is largely simple and marginal to semi-invasive and restricted to the dorsal surface at the distal end of the flakes.

Single side scrapers (n=3)

Like end scrapers, this class of artifacts is found in CSU-I and CSU-II only. Two of them are retouched on the right lateral side while one of them is retouched on the left lateral side. Retouch is either unifacial or part-biclinal. Raw materials that were used to make these scrapers were basalt and chert.

End and side scraper (n=2)

All on cortical basalt flakes, these scrapers have a plano-convex cross section. Both have a plain platform and are marginally or semi-invasively retouched on their dorsal or ventral surface. These scrapers are restricted to CSU-II. The mean length, width, and thickness is 26mm (sd=4mm), 41mm (sd=2mm), and 13mm (sd=1mm) respectively, while the mean weight is 17g (sd=6g).

Notches (n=6)

Four of them are on cortical basalt flakes while two of them are on slate. This is the only site with such raw material. They have either irregular or triangular cross sections. The retouch is simple and located on the dorsal or part-biclinal edges. The mean length, width, thickness, and weight are 35mm (range 19-53, sd=15), 28mm (range 18-42, sd=11), 15mm (range 8-29, sd=10), and 16g (range 4-16, sd=12) respectively.

Circular scrapers (n=3)

These scrapers are triangular in cross section, with semi-invasive simple or stepped retouch on the dorsal and/or ventral side. Two of them are in quartz and one on basalt. Two of them come from CSU-I and one of them from CSU-II. The mean length, width, thickness, and weight are

50mm (range 43-64, sd=12), 47mm (range 42-58, sd=9), 29mm (range 25-36, sd=6), and 74g (range 42-132, sd=50) respectively.

Light duty core scrapers (n=4)

With marginal to semi-invasive retouch these are on quartz and chert raw materials. They come from CSU I and II.

Backed Implements (Fig. 4.19-4.20)

Ba'ati Ataro yielded 12 backed implements comprising only 3% of the total lithic assemblage. All of them come from CSU I and II. They are mainly from basalt and quartz. Backing type is mainly bidirectional (Fig 4.20). They are discussed in the following sections.

Orthagonal truncation (n=3)

All are bi-directionally backed on either the distal or proximal side and are from quartz, chalcedony, and chert. They have irregular or sub triangular cross section and are found at CSU-I and II. The mean length, width, thickness, and weight are 22mm (range 19-27, sd=5), 26mm (range 19-35, sd=8), 8mm (range 6-10, sd=2) and 5g (range 3-8, sd=3) respectively.

Oblique truncations (n=3)

These are from quartz and basalt with backing located on the distal side or distal end. They come from CSU-I and CSU-II. The mean length, breadth, thickness, and weight are 25mm (range 21-30, sd=5), 18mm (range 17-18, sd=0.6), 9mm (range 6-11, sd=3) and 4g (range 3-4, sd=0.5) respectively.

Curved backed (n=2)

These are restricted to CSU-I. They are on quartz raw material with sub-triangular cross section. Backing is bi-directional. Mean length is 20 mm, mean width and thickness is 11mm and 5mm respectively, while the mean weight is 2g.

Miscellaneous backed (n=3)

These are found in CSU-I and II. These pieces have triangular or rhomboid cross sections. Backing is either bi-directional or ouchtata. They are on quartz or basalt. Mean length, width, and thickness are 24mm (range 15-40, sd=14), 27mm (range 12-47, sd=18), and 9mm (range 3-18, sd=8) respectively.

Double backed (n=1)

This is on basalt cortical flake that has a parallelogram cross section. This is limited to CSU-II and is 17mm long, 11mm wide, and 4mm thick.

Miscellaneous Shaped Tools

Ba'ati Ataro also yielded various other shaped tools that could not be put in the standard tool classes. These include composite tools such as three backed and scraper (mean length=49mm, mean width=45mm and mean thickness=13mm; basalt). It also yielded two heavy duty tools, a quartz core scraper and chopper, both from CSU-II (Figs 4.21-4.22a). The scraper is scalariform retouched on all its dorsal sides. There were three flake scars on the chopper.

Ground Stone Implements (n=34; Figs. 4.22b-4.24)

This is one of the two sites that contained ground stone implements; and the only site with such a high frequency. The other site to contain a ground stone implement is Dabo Zelelew where only one upper grinding stone of basalt is found. At Ba'ati Ataro, ground stone implements account for more than 7% of the total artifacts found at the site (n=468). They are either of basalt or sandstone, the latter being all lower grinding stones. While the upper grinding stones are found in CSU-I and CSU-

II, lower grinding stones are restricted to CSU-II only, all of which were found broken with differing dimensions. One lower grinding stone, for instance, although broken is 40 cm long and 27 cm wide.

Pottery (Figs. 4.25-4.27)

Ba'ati Ataro yielded a total of 642 potsherds, consisting of 55 rims (8.6% of the total ceramic assemblage), 7 handles (1.1%), and 4 (0.6%) bases. While almost all the rims are straight the handles are mostly knobs (Fig. 4.26). The remaining 576 or 89.7% are body sherds. Wall thickness of each of these and the total showed little change across the stratigraphic units except for the bases whose mean wall thickness is 25 and 12mm at CSU-II and CSU-I respectively.

Most of the sherds were gray or black in color while the most common inclusions are quartz and rock fragments. There are only two sherds with grog paste. Their earliest occurrence is at the bottom of CSU-II at ca 245cm below surface. There appears to be no difference of fabric in the ceramics of the site from their first appearance throughout the sequence to the higher layers. However, the potsherds were not proportionately distributed across the layers (Fig. 4.25). There are two peaks between ca.20-60cm and

ca.115-165cm below surface. However the density is very low between ca.60-115cm below surface in spite of the fact that there were three units excavated to that depth.

Only 12 (1.9%) of the 642 potsherds contained some form of decoration (Fig. 4.27). The decorations are restricted to simple incisions; and sometimes only one incision may characterize the decoration. But it is interesting to note that when pottery appears for the first time at this site it does so with decoration. Paste composition and frequency differed little in the sherds, as did hardness and color. Few of the sherds at CSU-II were burnished while many sherds showed sooting, some on the outside and some on the inside.

Faunal Remains

As with Danei Kawlos (Chapter 3), the faunal samples from Ba'ati Ataro were also studied by Dr. F. Marshall. Based on the report (Appendix B), the cultural stratigraphic units contained the following identified specimens.

CSU-III

Although there were many bones from this culture stratigraphic unit, most of them were in fragmentary

condition and only four of them were identified. Of these two were dik dik bones, one hyrax, and specimen represented domestic cattle.

CSU-II

By contrast this culture stratigraphic unit contained a large sample, although only 15 were identified. Seven of these are cattle, five caprines, one dik dik, and one tortoise.

CSU-I

This culture stratigraphic unit contained identifiable specimens consisting of six domestic cattle and five caprines.

Soil Samples

Soil samples were submitted to Dr. C. D'Andrea but as yet no seeds have been identified (see chapter 3 for details).

Summary of Ba'ati Ataro

Ba'ati Ataro contains more than 2.5m of cultural sediments. Occupation of the site began right from when the cave was a bedrock by people who had aceramic lithic artifacts composed of chert and chalcedony. This industry

quite abruptly changes at the beginning of CSU-II into one that is dominated by basalt and quartz, a shift that shows the dependence on locally available raw material procurement and use. This shift comes together with a new technology, pottery and the use of grinding stone implements at the same time. This is also indicated on the major composition of the lithostratigraphy which changes from a sandy to a predominantly loam sediment. These artifacts continue throughout the sequence until the beginning of CSU-I in which case a new raw material, obsidian, appears, together with an entirely new technology, iron. It is, however, interesting that pottery does not show any major change throughout the sequence

Domestic stock are present from the earliest layers of the site, although they do not become common until later. Only one specimen of domestic cattle is present in CSU-I but cattle make up 46% (7/15) of the identified fauna at CSU-II. All the identified specimens at CSU-I are domestic cattle and caprines. The inhabitants of the cave, therefore, depended on a mix of domestic and wild fauna in the earliest layers but exclusively exploited domestic fauna in the upper layers.

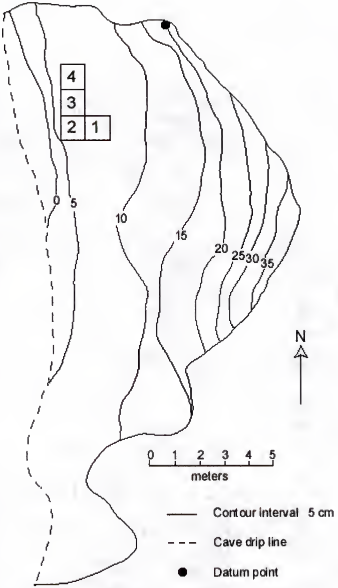


Fig. 4.1 Plan of Ba'ati Ataro showing Excavated Test Units

Key to Figure 4.1 (next page)

1. 10 YR 5/4 yellowish brown loam
2. 10 YR 4/4 dark yellowish brown loam packed with cowdung like a concrete
3. 7.5 YR 2.5/1 black compact loam
4. 7.5 YR brown sand with cowdung
5. 10 YR 6/3 pale brown sand
6. 2.5 Y 8/3 pale yellow silty sand
7. 2.5 Y 8/6 yellow loosely compacted silty sand
8. 10YR 2/1 black loam
9. 10YR 3/4 dark yellowish brown sandy loam
10. 2.5Y 8/4 pale yellow rough sand
11. 10YR 2/1 black loam
12. 10YR 5/8 yellowish brown sandy loam
13. 10YR 2/1 black sandy loam
14. 2.5Y 5/4 light olive brown clayey loam
15. 7.5 YR 3/4 dark brown loam
16. 2.5 Y 7/3 dark olive brown loam
17. 2.5 Y 5/3 light yellowish brown loam
18. 7.5 YR 3/4 dark brown loam
19. 2.5Y 7/3 pale yellow unconsolidated angular gravely conglomerate interspersed with sand
20. 7.5 YR 2.5/1 black loam
21. 7.5 YR 2.5/2 very dark brown loam
22. 5YR 3/6 dark reddish brown sandy clay
23. 10YR 4/6 dark yellowish brown sandy loam
24. 2.5YR 3/6 dark red sand

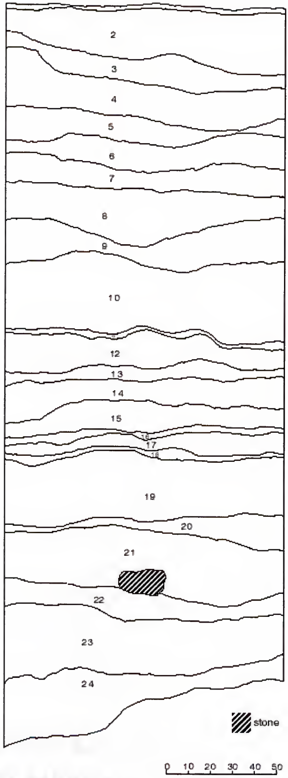


Fig. 4.2 Profile Map of the Eastern Wall of TU1, Ba'ati Ataro

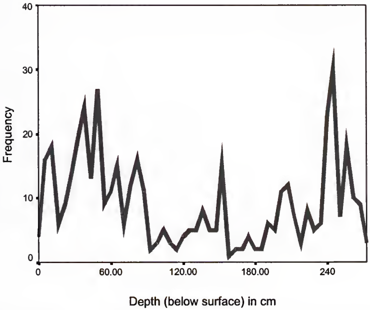


Fig. 4.3 Frequency of Lithic Artifacts by Depth at Ba'ati Ataro

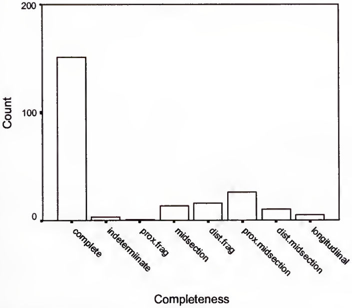


Fig. 4.4 Completeness of Flakes at Ba'ati Ataro

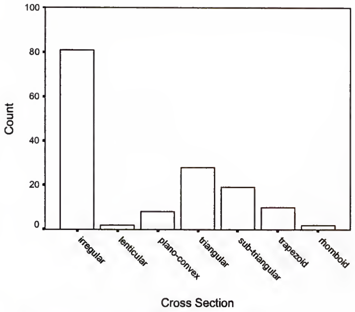


Fig. 4.5.Cross Section of Ba'ati Ataro Flakes

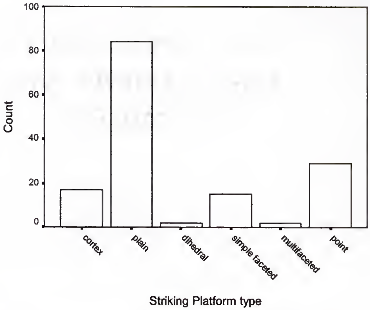


Fig. 4.6 Striking Platform Type of Ba'ati Ataro Flakes

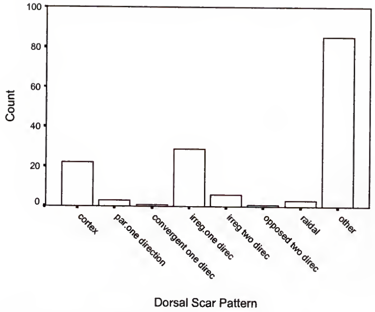


Fig. 4.7 Dorsal Scar Pattern of Ba'ati Ataro Flakes

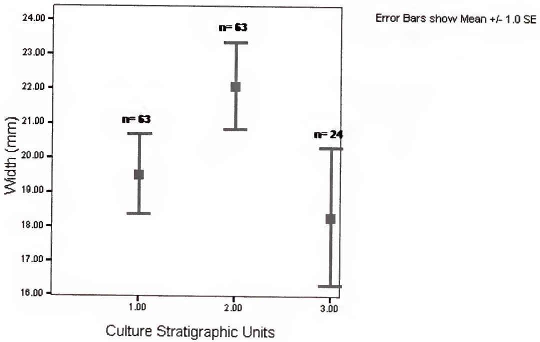


Fig. 4.8 Mean Width of Flakes from Ba'ati Ataro

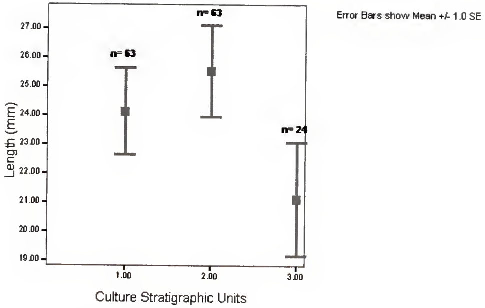


Fig. 4.9 Mean Length of Flakes from Ba'ati Ataro

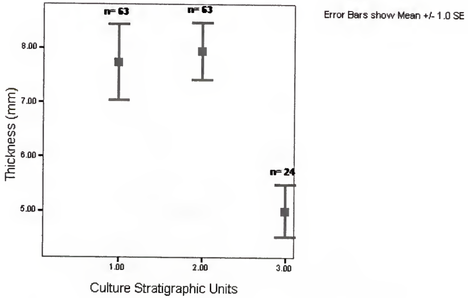


Fig. 4.10 Mean Thickness of Flakes from Ba'ati Ataro

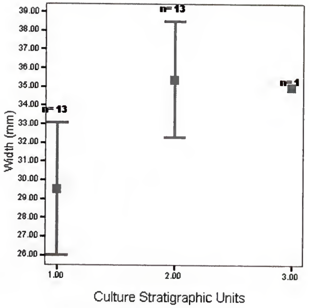


Fig. 4.11 Mean Width of Scrapers from Ba'ati Ataro

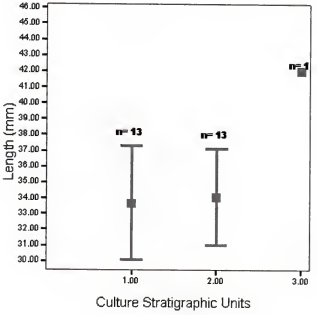


Fig. 4.12 Mean Length of Scrapers from Ba'ati Ataro

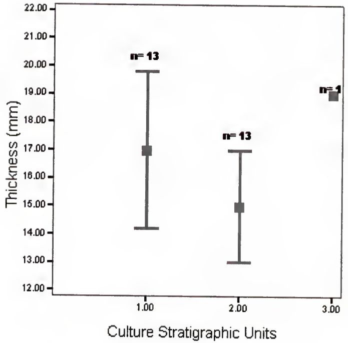


Fig. 4.13 Mean Thickness of Scrapers from Ba'ati Ataro

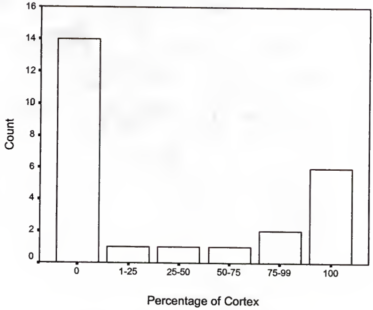


Fig. 4.14 Ba'ati Ataro Scrapers by Cortical Surface

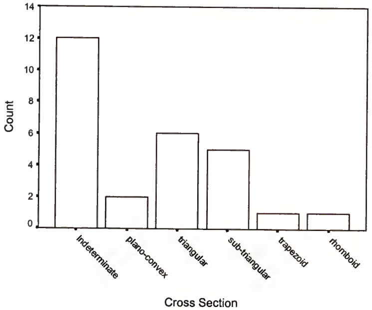


Fig. 4.15 Ba'ati Ataro Scrapers by Cross Section

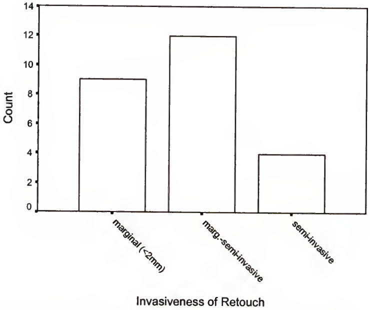


Fig. 4.16 Invasiveness of Retouch of Ba'ati Ataro Scrapers

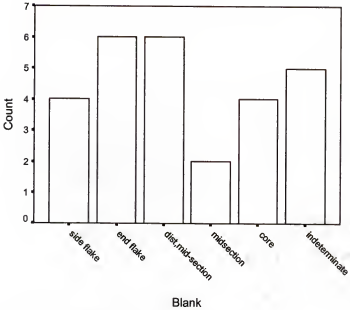


Fig. 4.17 Ba'ati Ataro Scrapers by Blank

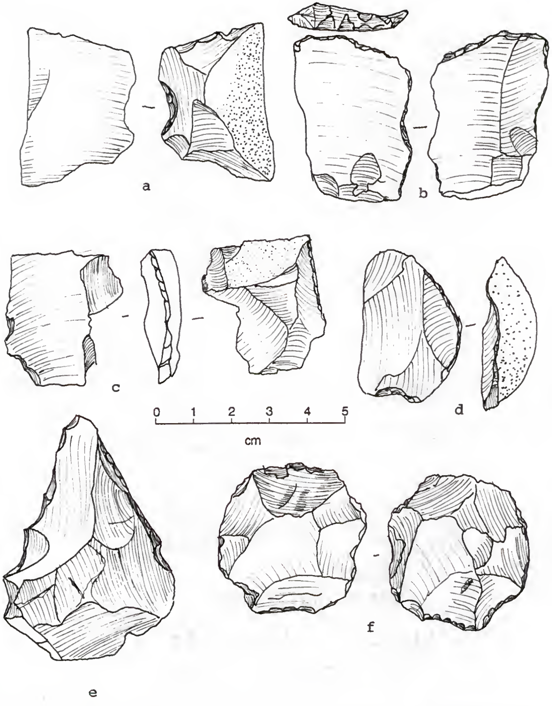


Fig. 4.18 Scrapers from Ba'ati Ataro, CSU-II; a. notch, basalt; b. double side and end scraper, chert; c. single side scraper, basalt; d. end and side scraper, basalt; e. triangular/convergent scraper, quartz; f. circular scraper, quartz.

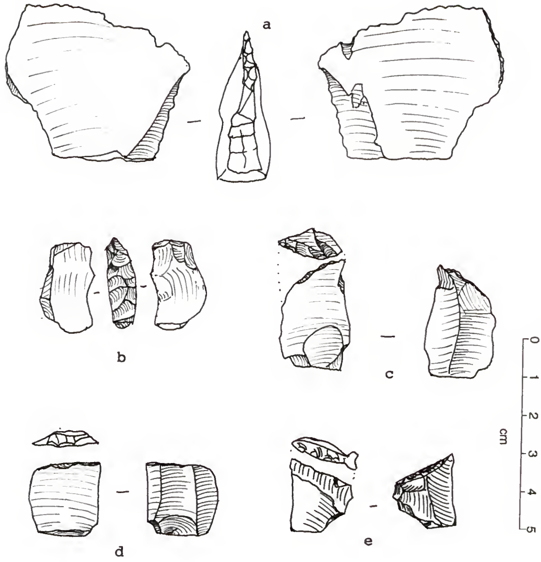


Fig. 4.19 Backed Implements from Ba'ati Ataro; a. miscellaneous backed, CSU-II, basalt; b. miscellaneous backed, CSU-I, quartz; c. oblique truncation, CSU-II, quartz; d. orthagonal truncation, CSU-II, chert; e. oblique truncation, CSU-I, quartz.

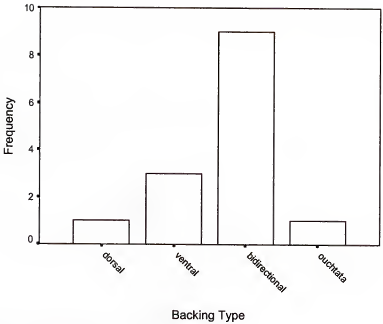


Fig. 4.20 Backing Type at Ba'ati Ataro

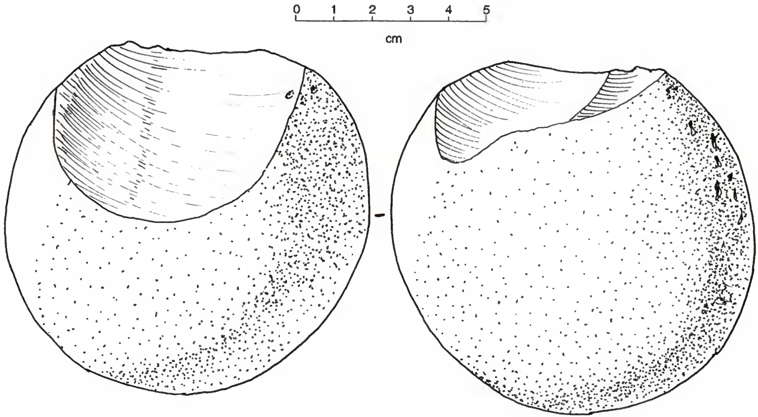


Fig. 4.21 Heavy Duty Chopper from Ba'ati ataro, CSU-II

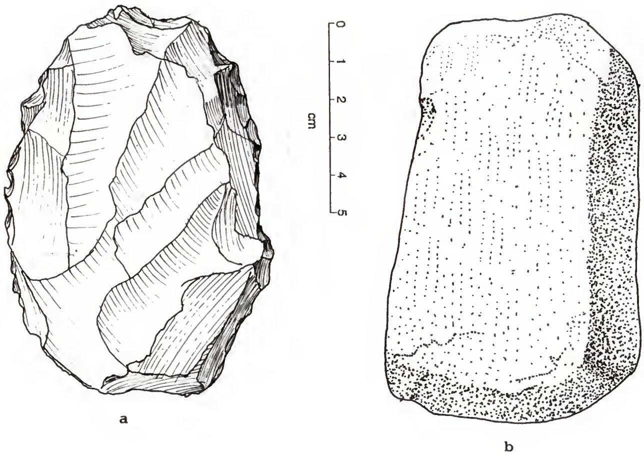


Fig. 4.22 Heavy Duty Tools from Ba'ati Ataro; a. Core Scraper, quartz, and b. Grinding Stone, basalt.

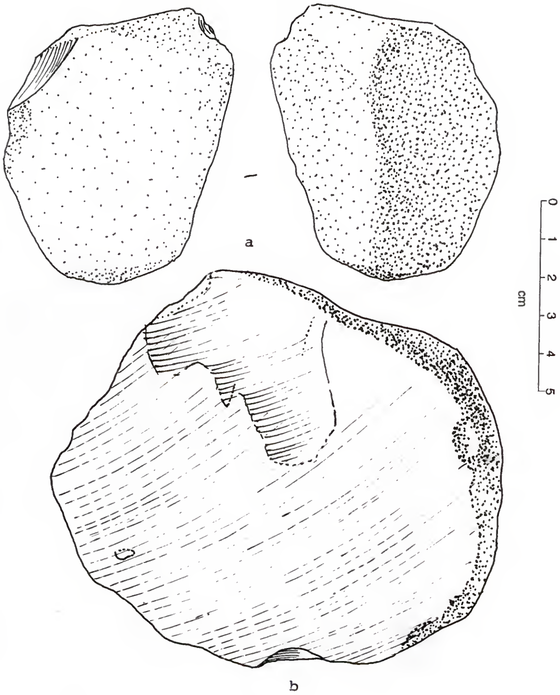


Fig. 4.23 Ground Stone Implements from Ba'ati Ataro, basalt.

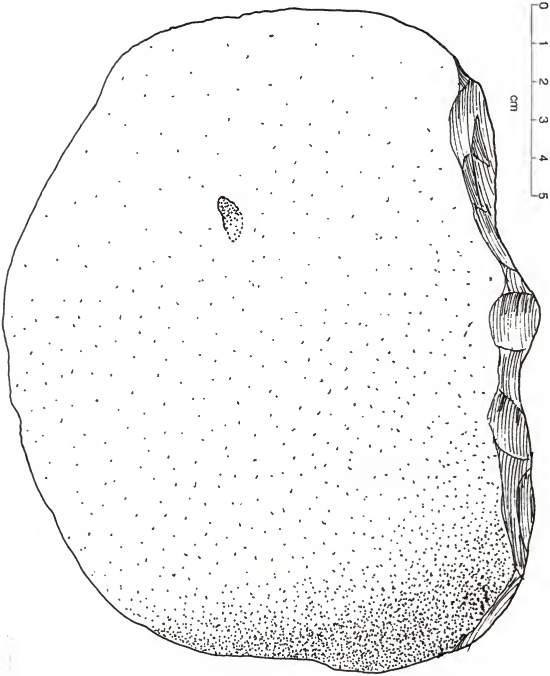


Fig. 4.24 Ground Stone Implement from Ba'ati Ataro, basalt.

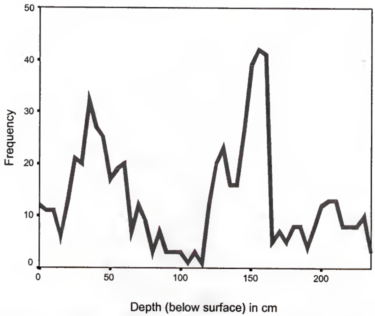


Fig. 4.25 Pottery Frequency by Depth at Ba'ati ataro

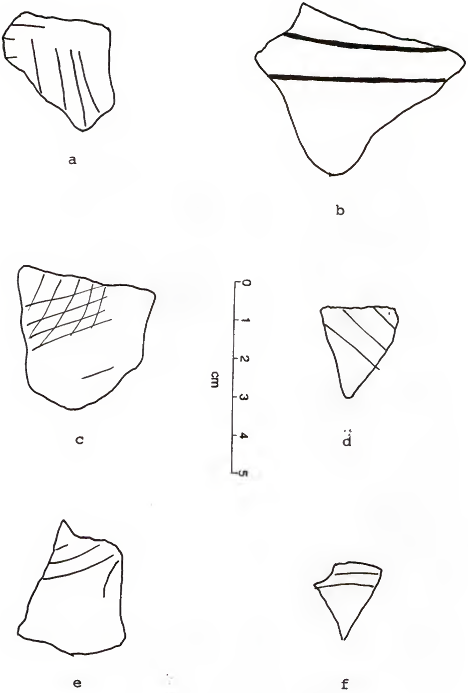


Fig. 4.26 Decorated Potsherds from Ba'ati Ataro

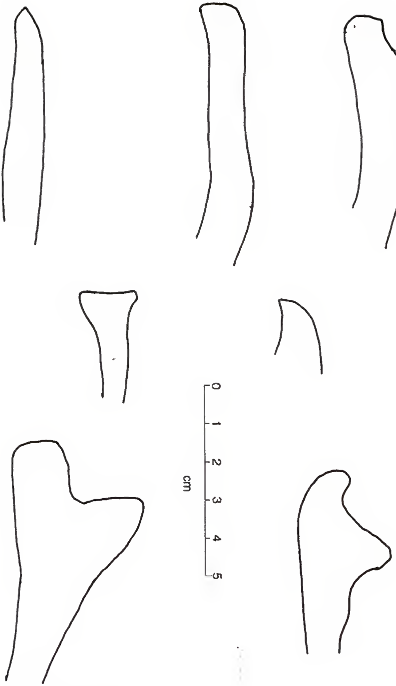


Fig. 4.27 Rim Types from Ba'ati Ataro

CHAPTER 5
THE SITES OF DABO ZELLELEW, SHEGALU, AND EMBA AHMEDIN

When I initially set out to do field work I had selected to test excavate five sites based on the surface distribution of lithic and ceramic artifacts as well as the potential for subsurface deposits in undisturbed contexts. I intended to conduct test excavations at these sites and determine the most promising ones for intensive research. Realizing that activities undertaken in shelters and caves may be different from open-air sites (e.g., main homesteads are expected to be in the open, while shelters may act as temporary corrals), at least one cave and one open air site were to be selected for more detailed investigations.

However, while the sites of Danei Kawlos (Chapter 3) and Ba'ati Ataro (Chapter 4) proved to have deep deposits and the grid squares were expanded to five and four m^2 respectively, the subsurface deposits of Dabo Zellelew (EjJu17a); Shegalu (EjJu11), and Emba Ahmedin (EjJu1) were shallow and did not go any deeper than a few levels. Therefore the initial 1 m^2 grid was not expanded. As a result, these sites yielded fewer cultural materials.

The site of Dabo Zelellew (EjJu 17a)

Located just outside the dripline of the cave of EjJu17 (Fig. 1.2) and extending at least another 10 meters to the west and north, EjJu17a was test-excavated to ca.50cm below surface. The lowest levels are composed entirely of lithics while the mid-to-upper layers contain a combination of lithics and potsherds and a few fragmentary bones that could not be identified to any taxonomic level.

Only a single 1 m^2 test unit was excavated at this site (see chapter 3 for excavation procedures). It has a simple stratigraphy that is composed of a yellowish red (5YR 4/6) unconsolidated sand, and continues to bedrock without changing. The cultural materials recovered from this site consist of lithic tools (n=264) and potsherds (n=31). Most of the lithic artifacts are concentrated in levels 2, 3, and 4. Levels 5 and 6 contain only 5% of the total lithic assemblage and the next two levels (7 and 8) contain only "tool trimming debris." The site was excavated to 50 cm below surface, but levels 9 (40-45 cm) and 10 (45-50 cm) were sterile.

Chert and quartz are the most dominant raw materials, comprising more than 51% and nearly 40% of the lithic artifacts respectively; chalcedony comprises only 8% of the total lithic assemblage. Other materials constituted less

than one percent of the raw materials. Although there were some obsidian artifacts observed scattered in the vicinity of the site, there was no such artifact recovered from the excavated unit. Also interesting is the fact that although basalt is available everywhere there was no basalt artifact at the site except for the grinding stone implement from level 4. This is particularly curious since Dabo Zelelew is situated somewhere in between Ba'ati Ataro and Danei Kawlos (Fig. 1.2) which, as we have seen, contain abundant basalt and obsidian artifacts respectively. It should, however, be noted that only one test pit was excavated at Dabo Zellelew, and it may not be representative of the site.

As mentioned above, Dabo Zellelew yielded a total of 264 lithic artifacts (Table 5.1). The unmodified waste at the site constitutes 93% of the total lithic assemblage. Of these, angular waste comprises 18% while broken flakes make up 27%. There are only three multi-platform cores, all from level one and the surface. There are hundreds of chert and quartz tool trimming debris from level 7 to 2, but because they are too small for metric analysis these were not included in this analysis. Most of these are from level 6 and decrease in abundance in the upper levels indicating the gradual decrease of artifact manufacture at the site.

Table 5.1 Inventory of Lithic Artifacts from Dabo Zellelw

Artifact Type	Level							Total
	Surface	1	2	3	4	5	6	
SCRAPERS								
Single side scraper			1		1			2
end and side scraper					1			1
circular/semi-circular scraper			1					1
double side and end scraper		1						1
notched scraper				1	1			2
core scraper				1				1
scraper fragment					1			1
SUB-TOTAL		1	2	2	4			9(3.4%)
MICROLITHS								
crescent		1		1				2
curved backed		1	1					2
backed fragment		1						1
orthagonal truncation					1			1
SUB TOTAL		3	1	1	1			6 (2.3%)
OTHER TOOLS								
burin					1			1
percoir	1							1
scraper bec				1				1
grinding stone				1				1
SUB TOTAL	1			2	1			4 (1.5%)
UNMODIFIED WASTE								
whole flake	8	17	31	35	9	7	2	109
broken flakes		7	20	26	11	1	1	66
blade		1	3	7	5	1		17
flake talon fragment				1				1
multiple platform core	1			2				3
angular waste	1	5	11	16	11	1		45
unmodified pebble	1		2	1				4
SUB TOTAL	11	30	67	88	36	10	3	245 (92.8%)
GRAND TOTAL	12	34	70	92	43	10	3	264 (100%)

Whole flakes account for 44% of the unmodified waste and 41% of the total lithic assemblage. There are 109 whole flakes with a mean length of 19mm (sd=9mm), width of 16mm (sd=7), and thickness of 5mm (sd=3); there is no patterned increase or decrease from these metrical data across the levels.

The flakes are from chert, quartz, chalcedony, and limestone raw materials. The majority of the flakes (53%) are from chert while about 40% of them are from quartz. Chalcedony forms 10% and there is only one limestone flake. All levels contain quartz and chert artifacts. However level 2 encompasses one limestone while chalcedony is absent from the two lower layers (levels 6 and 5).

By far the great majority of flakes at Dabo Zelelew (nearly 80%) are non-cortical. The cross section, however, shows much variability (Fig. 5.1). Thus while about half of them have triangular or sub-triangular cross sections, the rest were trapezoidal, lenticular or biconvex in cross section. Most of the flakes have undetermined scar patterns but more than 30% of the flakes had one directional scar pattern that was either parallel, convergent, or irregular, indicating that they were struck from a single platform core. End struck flakes dominate the flake assemblage as does a plain striking platform type (Fig. 5.2). However about 21% of them have simple or multifaceted striking platforms, while about the same number have pointed platforms. Most of the flakes are also edge damaged. This showed some pattern across the levels. Thus, all the flakes at the two lowest levels were edge damaged, while flakes

tend to show no evidence of edge damage in the upper levels.

Although the lithic assemblage is dominated by flakes and angular waste, there indeed are shaped tools at the site (Table 5.1; Fig. 5.3). These include scrapers, microliths, and other shaped tools. The site also contains the only grinding stone implement at level 4.

Dabo Zelelew yielded 18 shaped tools and one grinding stone implement, constituting less than 7% of the total lithic assemblage. Of these half are scrapers of different forms found in the upper four levels (Table 5.1). Some of them are marginally retouched while there were also others that were grouped into the semi-invasive to invasive retouch category. The most prevalent retouch class is unifacial-obverse (dorsal) and the majority had a simple retouch type. Only one had a part-biclinal retouch. Retouch location and direction is presented in Table 5.2.

The scrapers were made up of three types of raw materials: quartz, chert, and chalcedony. While chert and quartz are present in layers 1-3, chalcedony appears only in level 4. The only scraper from level one was heat treated.

The majority of the scrapers (seven) were on non-cortical flakes with dorsal scar patterns varying between

convergent one direction and irregular one or two directions. The majority are also on flake blanks (Fig. 5.4) with differing cross sections (Fig. 5.5).

Table 5.2 Retouch Direction and Location of Scrapers from Dabo Zellelew

Retouch location and direction	No. of scrapers
Obverse, left lateral	1
Obverse, right lateral	1
Obverse, distal and both laterals	2
Obverse, proximal	1
Obverse, indeterminate	2
Inverse, proximal	1
Part biclinal, semi-circular	1
Total	9

The mean length, width, thickness, and weight of all the scrapers are respectively 26mm (sd=12), 25mm (sd=9), 8mm (sd=3), and 7g (sd=6). Although the sample size is too small to be statistically significant, the mean width steadily decreases through time from 29 to 15 mm. Except for level 4 the mean thickness also decreases from 9 to 3 mm. On the other hand mean length increases from level 4 to level 2 (by 15 mm) (Figs. 5.6-5.8).

There are six types of scrapers at Dabo Zellelew (Table5.1). The mean retouch angle of all these is 60° (range 35° to 85°, sd=18°). These values make them fall in the blunt and steep retouch category.

Dabo Zellelew also yielded backed implements (Table 5.1; Fig. 5.3). These are from quartz, chert, and chalcedony and come from levels 4 to 1. They are from non-cortical, largely indeterminate blanks, and have a sub-triangular cross section and bidirectional backing. Of particular interest are the crescents whose thinness calls attention to those of Danei Kawlos.

Other shaped tools recovered from Dabo Zellelew include a burin from level 4 (chert), a percoir from the surface (quartz), a scraper bec from level 3 (chert), and a basalt grinding stone from level 4.

There are also 31 potsherds that were excavated from this site. They are all found in fragmentary condition and as a result vessel shape could not be determined. All but two of them (which are rims from level one) are body sherds. Levels one to four contain 7, 14, 8, and 2 potsherds respectively. While the mean wall thickness of the rims is 11mm, the body sherds are on average 10mm (sd=3mm) thick, with no major changes across the levels from these averages. Most of the sherds are gray but there are black and red sherds as well, which again, do not show any change across the levels. Rock fragment and quartz inclusions are common. There are only five decorated

sherds, which are limited to simple incisions with single line motifs.

The site of Shegalu (EjJu 11)

There is no local name for this cave (Fig. 1.2). However, since there is a river by the name Shegalu that passes immediately in front of this cave, I have named the cave Shegalu. This is a comparatively large cave measuring 30m in length, 8 m in depth, and ca. 4 m in height. This is also a classic example of a cave that people still use for protecting livestock from rain; current shepherds have constructed stone piles that divide the cave into "rooms".

The cave is located some five meters above the bed of the Shegalu stream. It faces north and has part rocky and part dirt floors. A 1 x 1 m unit was laid out at the cave and excavated to bedrock which appeared at ca.25 cm below surface. A total of 111 lithic and 30 ceramic artifacts were unearthed from the five levels of this site. Level 3 contained 56% of the lithic artifacts but contained no pottery, while level 5 yielded 70% of the potsherds. While all the levels had lithic artifacts, all but level 3 had pottery.

The lithic artifacts are composed of flakes (n=52); blades (n=2), single platform cores (n=2) and angular waste

(n=54). There is only one shaped tool (a miscellaneous backed piece). Ninety percent of the artifacts are of basalt while there were only five chert, five quartz, and two limestone artifacts.

The mean length, width, and thickness of the flakes decrease across time (Fig. 5.9-5.11). Most of the flakes have full or varying degrees of cortex and showed edge damage/utilization. The only backed implement from the site is on a cortical basalt, with an indeterminate cross section.

There are only 30 potsherds that were found in all but level three of the site; the highest density occurs at level five where 70% of them are confined. Refitting was not possible as they are all found in a fragmented condition. They are all body sherds, except for four rim sherds (one from level 1 and three from level 5). There were no handle nor base fragments. Four of them are broken rims while the rest are body sherds. The former had a mean wall thickness of 12 mm while the latter are on average 16 mm thick. All the rims are found in level 4; while the body sherds are distributed across all the levels. The mean wall thickness of the sherds does not show any major change from the total mean through the levels. Except for one decorated sherd (Fig. 5.4-e) from level 4, all are plain body sherds.

There are no burnished or slipped sherds at this site. The color of the sherds varied from black to gray to dark gray. Most of them have hard surfaces. Two types of inclusions are observed in the sherds: rock fragments and quartz.

The site of Emba Ahmedin (EjJu 1)

Emba Ahmedin, a rock shelter at the base of the sandstone hills surrounding the modern town of Abiy Adi, was excavated to ca. 25 cm below surface to bedrock. There is no change in stratigraphy. It is composed of a reddish gray (2.5YR 5/1) loam which continues to bedrock. Unlike all the other sites that were excavated, this site yielded no lithics. However, there are 22 potsherds, of which two are rims, while the rest were body sherds. Like the other sites, refitting was not possible. There were four colors that were observed at the site, red, black, gray, and dark gray. By far the most (73%) are gray colored and 50% of them had quartz and rock inclusions. There were no decorated sherds.

The rims come from levels four and five with a thickness of 15 and 10 mm respectively. The rest of the body sherds are found across all the levels, but level 5

contained the most. The mean wall thickness of all the sherds is 8 mm.

General Summary

As opposed to Danei Kawlos (chapter 3) and Ba'ati Ataro (chapter 4) there were only 1 m^2 test units excavated at the sites of Dabo Zellelew, Shegalu, and Emba Ahmedin. As can be seen from the preceding discussion the sites of Shegalu and Emba Ahmedin could not be excavated deeper than 25 cm. There is no charcoal found in the excavated squares of all these sites and the ages of the cultural materials could not be chronometrically determined. However, it is worth noting that while the raw material composition of lithic artifacts of Dabo Zellelew is similar to those fom CSU-III of Ba'ati Ataro. The shaped tools, particularly the thinness of the crescents, call attention to those of Danei Kawlos. The dominance of basalt in the lithic artifact composition of Shegalu is similar to those at CSU-I and II of Ba'ati Ataro. The general similarities of Emba Ahmedin potsherds to those of CSU-I and II of Ba'ati Ataro should also be noted.

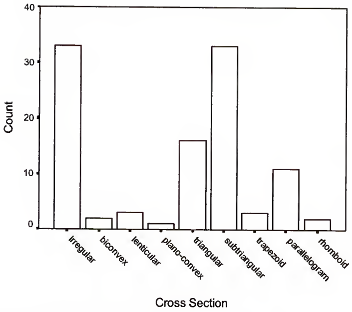


Fig. 5.1 Cross Section of Dabo Zellelew Flakes

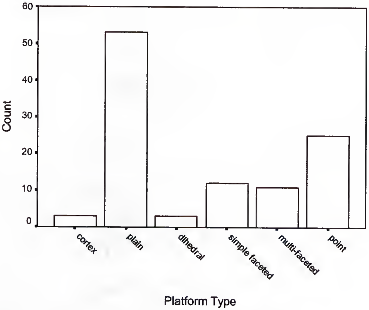


Fig. 5.2 Platform Type of Dabo Zellelew Flakes

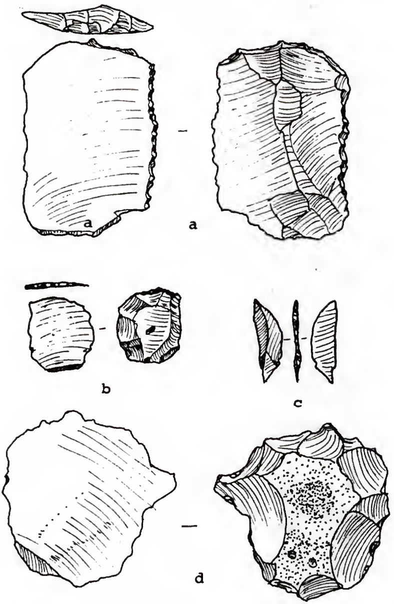


Fig. 5.3 Shaped Tools from Dabo Zellelew, actual size; a. double side and end scraper, chert, level 2; b. orthagonal truncation, chert, level 4; c. crescent, chert, level 3; d. scraper bec, chert, level 3.

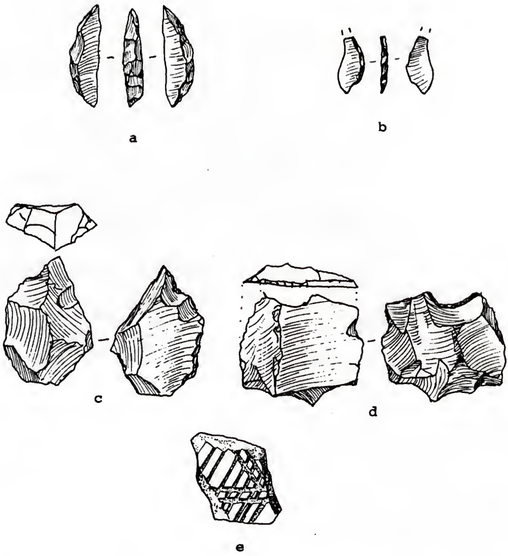


Fig. 5.4 Shaped Tools from Dabo Zellelew (a-d) and a Decorated Sherd (e) from Shegalu, actual size; a. curved backed, chert, level 1; b. broken microlith, chalcedony, level 1; c. percoir, quartz; d. notch, chert, level 3.

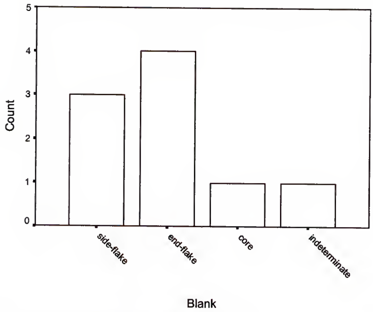


Fig. 5.5 Dabo Zellelew Scrapers by Blank

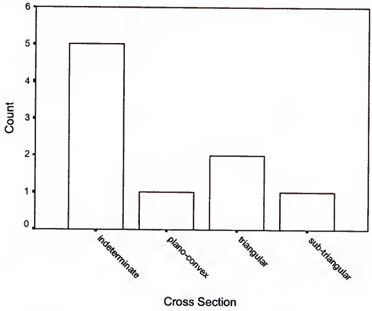


Fig. 5.6 Cross Section of Dabo Zellelew Scrapers

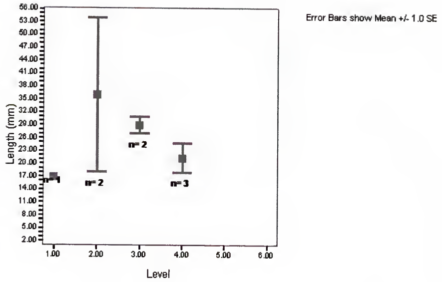


Fig. 5.7 Mean Length of Dabo Zellelew Scrapers by Level

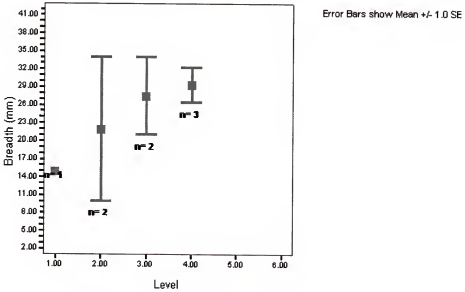


Fig. 5.8 Mean Breadth of Dabo Zellelew Scrapers by Level

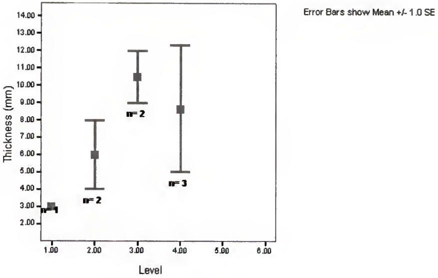


Fig. 5.9 Mean Thickness of Dabo Zellelew Scrapers by Level

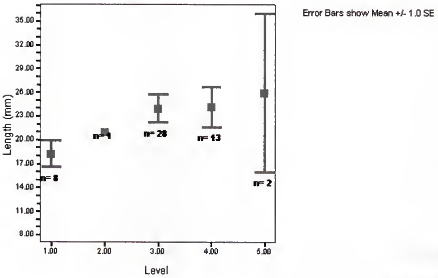


Fig. 5.10 Mean Length of Shegalu Flakes by Level

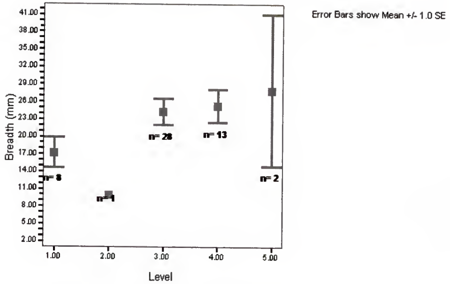


Fig. 5.11 Mean Breadth of Shegalu Flakes by Level

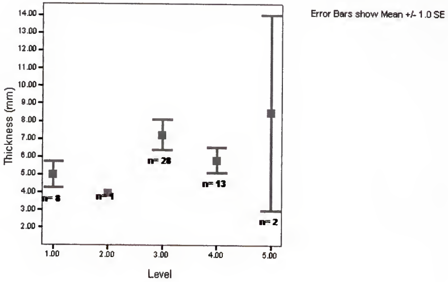


Fig. 5.12 Mean Thickness of Shegalu Flakes by level

CHAPTER 6
ROCK ART IN TEMBEN AND THE HORN OF AFRICA

Rock art, although restricted to the LSA/Neolithic and not found everywhere (and unfortunately when found, not fully utilized) is an informative source of evidence in the reconstruction of the distribution of animals and their habitats, besides providing clues to human subsistence patterns. In the case of the Horn, it is also important in identifying the timing of the introduction of domesticates as it is generally accepted that domestic livestock were introduced from elsewhere to this part of the Horn of Africa.

As mentioned in the preceding chapters, the surveys I undertook in the Temben region of northern Ethiopia yielded rock art sites for the first time. This chapter describes these sites and attempts to look at them in light of the rock art of the Horn.

Distribution and Content of the Rock Art in the Horn of Africa

At this point it is necessary to discuss the distribution and thematic content of rock art in the Horn of Africa in order to understand the significance of the

Temben sites. The Horn of Africa, consisting the modern countries of Ethiopia, Djibouti, Somalia, and Eritrea, comprises of a number of rock art sites. There are a number of reports of the concentration of sites in Eritrea, particularly in the Mai Aini and Karora regions (e.g., Graziosi 1964), while the rock art found in northern and southern Somalia have been recently compiled (Carder 1988). Very little is known of the rock art (or for that matter of the archaeology) in Djibouti, although recent surveys have shown the presence of engravings (Joussaume 1995).

In Ethiopia, the presence of rock art in the Harar region (where there is high concentration) has been noted since the 1930's (Breuil 1934). In southern Ethiopia discoveries of rock art have been accumulating since they were first reported by Clark in the 1940's (Clark 1945; Anfray 1967, 1972; Dekker and Tesfaye 1972; Girma pers. Com.; Joussaume 1994). In northern Ethiopia there were only two rock art sites previously known. One is the rock engraving site that had been reported by Gigar (1979) in eastern Tigray; the other being a painting and mistakenly reported as found in Eritrea (Drew 1954). Recent surveys in the Temben region of northern Ethiopia have added to the repertoire of our knowledge of the distribution of rock art in northern Ethiopia (Agazi 1997a).

I have previously divided the rock art of the Horn of Africa to encompass three broad categories (Agazi 1997b): rock paintings, rock engravings, and rock carvings. The former encompasses the use of paint(s) in the drawing of any type of symbol or animal figures. Rock engraving refers to any type of pecked outlines of animal/human figures and symbols, while the net result of a rock carving, although it employs a form of engraving, is a figure or representation in the form of a relief.

It is interesting to note the distribution of such rock art. Thus, while there are paintings as well as engravings in Eritrea and northern Ethiopia (indeed at least one site contains both engravings and paintings [Agazi 1997a]), there are no engraving sites in eastern Ethiopia, although it is an area with the largest concentration of rock art. On the other hand the only sites that contain rock carvings are to be found only in southern Ethiopia. Southern Ethiopia is also the only area that contains all three types of rock art: there are paintings in the Yabello area (Clark 1945; Girma pers. com.), engravings in the Gamo Gofa area (Dekker and Tesfaye 1972), and rock carvings in the Dilla area (Anfray 1967, 1976; Joussaume 1994; and pers. obs.). In Djibouti all the rock art is in the form of engraving (Joussaume 1995).

The main themes of the rock art of the Horn is the representation of animal as well as human figures and geometric representations. In general, there is an extensive representation of domestic animals, especially cattle, in all types of the rock art of the Horn. Such predominance of domestic animals and the extreme rarity of wild animal representation in the rock art has been the reason for the use of the term "the pastoral rock art of the Horn of Africa" (Brandt and Carder 1987; Agazi 1997b). The very few sites that contain wild fauna represent "pictures" of lions, elephants, giraffes, and/or ostriches. Except at one site, where there is an engraving of a giraffe (Dekker and Tesfaye 1972), the rock art in southern Ethiopia contains only domestic cattle and geometric figures. In eastern Ethiopia there are some wild animals represented, while the engravings in Djibouti, in addition to domestic stock, display representations of elephants and giraffes, wild fauna that are non-existent in present day Djibouti (Joussaume 1995). In northern Ethiopia only two sites contain representations of wild fauna (ostriches and lions) but the main theme is domestic cattle and domestic scenes. To my knowledge there is no representation of plants in the rock art of the Horn of Africa.

Another aspect of the Horn of Africa's rock art is its inclusion of humans. However, humans are never "naturalistically" represented. Thus in Harar in eastern Ethiopia humans are usually depicted in the form of a capital H (Cervicek 1971; Clark 1954) while in northern Ethiopia humans are "drawn" with an elongated shape (Drew 1954; Graziosi 1964; Agazi 1997a). A common feature to all of the rock art is that the face is not represented in an anatomically correct fashion.

One aspect of the rock art that is peculiar to northern Ethiopia and Eritrea is that it depicts domestic scenes. Thus, humans are depicted doing their domestic chores such as milking. They are also represented playing a musical instrument; while at least at one site, humans are represented hunting or defending themselves against lions. Plowing is also a scene represented in northern Ethiopia while sometimes humans are seen armed with bows, arrows, and spears (Drew 1954; Graziosi 1964; and pers. obs.).

New Rock Art Discoveries in Temben

A number of rock art sites have recently been discovered in Temben. Most of them contain geometric engravings including circles, squares, and lines of different designs, but three of them contain paintings

and/or engravings of animal and/or human figures that can be assigned to an already established, albeit tentatively, chronological sequence of the rock art of the Horn of Africa (Brandt and Carder 1987; Cervicek 1979).

Dabo Zellelew (EjJu17)

Dabo Zellelew is a cave which is 4.6 m wide at the entrance but narrows down to only 80 cm at 14.4 m toward the interior from its opening. The cave is reported to extend for "many kilometers" in the mountain but at present is blocked (at 14.4 m) by artificial stone piles supposedly to protect ovicaprids from entering deeper into the cave. It contains both engravings and paintings, but the rock art is concentrated mainly at the entrance, for most of the walls and ceiling of the cave are covered with thick soot.

Facing north, this cave contains rock art on both sides of the entrance. The western side contains geometric engravings. On the eastern side are engraved humpless and longhorned cattle together with other geometric motifs. At least seven human figures are also represented (Fig. 6.1).

Some two meters inside the cave there is a small "hallway" that bifurcates from the main floors of the cave and leads to a window-like opening. Along the walls of this "hallway" are some paintings in white pigment. However,

most of the wall is covered with soot and only two outline depictions of cattle can be identified, others being just faint traces. This is the only part of the cave that contains paintings.

The cave has rocky floors. However, beyond the drip line of the cave is a small area with visibly thick soil deposits containing dense cultural material (artifacts and potsherds). This was test excavated and the results of this excavation are presented in Chapter 5.

Mihdar Ab'ur (EjJu22)

This is a very large cave (nearly 60 m wide) that faces southeast. It has a rocky floor but contains numerous traces of engravings of geometric figures. At least two humpless cattle are also observed (Fig. 6.2). However, no cultural material was observed on the surface of the cave or in the vicinity.

Tselim Ba'ati (EjJu34)

This is a very large cave that contains paintings only. Two art styles can be recognized. There is a large panel of faint traces of paintings in black, among which ostriches are clearly visible (Fig. 6.3). There are also very faint traces of humpless cattle. These paintings are small and naturalistic. These were undoubtedly executed

first as they are superimposed by a different style of paintings in tan pigment of humped cattle, a dog, and human figures (two of them riding a horse/donkey/mule(?), which has a rather exaggerated tail). Also present are human figures (Fig. 6.4-6.6).

There were no artifacts on the rocky floor of this cave but there was significant cultural material scattered all around the talus slope. Unfortunately, the slope is steep; and therefore no excavation was undertaken.

Dating the Rock Art

There is as yet no chronometric date for the rock art of the Horn of Africa. Investigators, therefore, have relied heavily on stylistic changes. Over the years, the style of rock art of the Horn of Africa has been "refined" from Breuil's (1934) first recognition of eight series of paintings, to Clark's (1954) three main themes, culminating in Cervicek's (1979) terminology that still remains the basis of rock art classification.

Breuil, writing in the 1930's, based himself on the few rock art sites then known, and his conclusions were really based on superposition rather than "styles." Sometime later, Clark (1954), who had more sites at his disposal, was able to narrow it down to three main styles:

an early naturalistic series; a subsequent conventionalized rock art; and the last schematic series of rock art. On the basis of the thirteen rock art sites that he visited in eastern Ethiopia, Bailloud (1965) saw an "archaic" series of paintings which he termed "Ourso style" that was succeeded by a late "Laga Oda style" (both are rock art sites in eastern Ethiopia). Indeed, basing himself on the distribution of lithic artifacts Bailloud was to refer to the artists as "Wiltonian" cattle/ovicaprid herders.

However, it was not until Cervicek's 1979 article, in which he compared rock art styles of Ethiopia and Arabia, that he was to suggest an "Ethio-Arabian style" scheme that, with minor modifications, is still being used today. The Ethio-Arabian art style:

> shows the body and legs of the cattle in profile, the fore-legs and the hind-legs are each pooled to one thick line; the hoofs are sometimes stylized to resemble pincers but more often the legs have rounded ends dismissing the hoofs entirely. The head, neck and the horns of the animal are shown from the back like with a bovid which turns its head from the onlooker (Cervicek 1979:7).

While this is Cervicek's general characterization of the rock art, he still distinguishes two stages in the development of this style: an early "Surre-Hanakiya" stage and a later "Dahthami style proper." The former, named after the type site, Surre, in eastern Ethiopia, contains

rock art dominated by pastoral scenes of naturalistic and semi-naturalistic paintings and engravings. These are considered to be the earliest paintings in the Horn. The Dahthami style proper stage comes later and is divided into early and later phases: during the early phase the horns of cattle sometimes "degenerate" into formless stumps and in the more schematic representations the heads of the cattle are omitted, while in the later phase of this stage humpless cattle are replaced by zebu cattle and camels.

On the basis of paleoenvironmental and archaeological data, as well as on the hypothesized movements of pastoralists from the Sahara and the thematic and stylistic content of the rock art of the Horn, investigators have tentatively dated the Surre-Hanakiya stage to ca. 5000-3000 years ago; the early and later phases of the Dahthami style proper to ca. 2000 years ago and the 4th century AD respectively (Brandt and Carder 1987; Cervicek 1979). These dates coincide respectively with the arid conditions of the mid-Holocene, the return of humid and wet conditions around 2000 years ago, and the return of dry conditions shortly after.

The Temben rock art sites can be placed in the forgoing outline of chronology. The humpless cattle engravings of Mihdar Abu'r and Dabo Zellelew are similar to

those found in Djibouti (Joussaume 1995) and at Shepe and Galma in southern Ethiopia (Anfray 1967, 1976; and personal observation). However, the Shepe/Galma engravings show the cattle in bas relief, while those in Mihdar Abu'r and Dabo Zellelew are pecked outline representations.

Two styles of rock art are recognized at Tselim Ba'ati. The semi-naturalistic paintings have stylistic similarities to the earliest paintings found in eastern Ethiopia (Clark 1954; and pers. obs.) and Somalia (Brandt and Carder 1987; Carder 1988). The schematized paintings of cattle and humans also have similarities to the rest of the Horn, but they are believed to belong to a later stage.

The Dabo Zellelew and Mihdar Abu'r engravings as well as the naturalistic paintings at Tselim Ba'ati can all be placed in the earliest "Surre-Hanakiya" stage of rock art tradition in the Horn. The Dabo Zellelew paintings as well as the superimposed schematized paintings of Tselim Ba'ati belong to the later stage ("Dahthami style proper") of rock art in the Horn.

However, there is as yet no secure chronometric date for the rock art of the Horn of Africa and it is worthwhile to note that the above "ages of the rock art" are tentative. Although there have been recent advances in the chronometric dating of rock art, the Horn of Africa has not

shared in these advances. However, the use of organic materials in paintings has been noted in ethnohistorical literature elsewhere. If this is also the case in the Horn, then chronometric dates would free researchers from the sole preoccupation of reconstructing chronology and permit them to focus on the behavioral significance of the art.

It should also be mentioned that in view of current re-evaluation of the dates of Saharan engravings (e.g., Lupacciolu 1996; Mori 1974), which is where the pastoralists of the Horn of Africa were supposed to have come from, such later dates for the art of the Horn needs to be scrutinized. In any case, however, these new rock art finds suggest the presence of a food producing economy (at least pastoralism) in the Temben area at least since mid-Holocene times.

The "Meaning" of the Rock Art

Rock art represents one of the most difficult enigmas in archaeological interpretation. It is very liable to personal idiosyncratic interpretations and has been explained in many different ways even for the same rock art sites. The all too common interpretations are art for art's sake, esthetics, representational art, art as a hunting and fertility magic, art as a manifestation of rituals, and art

as a means of passing time. But there are some interpretations unique to Africa; i.e., attributing the "authorship" of rock art to outsiders. Indeed, some investigators (e.g., Breuil 1949) have attributed some of the rock art of South Africa to Phoenicians!

The problem of this interpretation is particularly magnified in areas where direct descendants of the art can not or has not yet been established (e.g. the Horn). Here the only attempt at giving meaning to the rock art of the Horn of Africa employs wide environmental, climatic, demographic, economic and social parameters (Brandt and Carder 1987). However, in areas where there are still direct descendants of artists and who still paint, or at least who were painting until very recently (e.g., in Australia) or where there is ethnohistoric evidence for the artists and whose ethnographies are written (e.g., South Africa.), these have been used to interpret the rock art.

Perhaps the best known discussion of rock art research in Africa, and indeed by any world standard, is to be found in South Africa. It is also a classic example of the shifts in the interpretation of rock art. For instance, Lewis Williams (1980, 1981, 1982) argues against previous works which maintain that rock art can offer almost no information about its producers' socio-economic and

ideological world and which focused on its esthetic qualities only. According to Lewis-Williams, previous innatist and functionalist interpretations of rock art are severely limited in that they ignore the social context of the rock art and because they assert that the art was painted for art's sake, that the San were artistic and painted the art as a pass time, and that the art is an idiosyncratic expression (indeed some have even gone to suggest the eidietic ability of the San [Wilcox 1984]). He contends that these assumptions lack theoretical ground in that they "depend entirely on their own responses to the art: the paintings delight them and they conclude that they were done to delight the artists and original viewers" (Lewis-Williams 1982:429). Such arguments, he contends, do not take ethnographic data into consideration.

Lewis-Williams also criticizes the functionalist interpretation of the art as inadequate. One such functionalist argument views the art as a remnant of sympathetic hunting magic. This interpretation, which was preconceived in Europe, maintains that by painting animals in deep inaccessible parts of the caves, the hunters were able to secure successful hunting. According to Lewis-Williams however, this does not hold true when it comes to South African paintings for a number of reasons: the

paucity of hunting scenes (e.g., in the Ndema Gorge there are only 29 hunts in 3909 paintings); the overwhelming majority of human figures in the art; and the absence of such practices in San ethnography which could substantiate their interpretation.

His alternative is to view the rock art in terms of "production in San society and the social relations of ideology associated with it", for the artists were "influenced by a web of social relationships, all of which had an economic or potentially economic component" (1982:431). He turns to the discussion of the /Xam (people related to the contemporary San of the Kalahari but who are now extinct) verbatim ethnography that has been preserved and data on the ethnographic present from the San in order to shed light on the economic and infrastructure and the relationship between the rock art and social relations. These social relations are believed to "control not only exploitation of resources and the distribution of products, but also marriage practices and the social framework of religious activity" (1982:431). By reducing tensions, curing illness, and depicting visions experienced during trance, medicine men are reported to have contributed towards the perpetuation of social relations and the social process of production. Thus "the art was

part of a symbolic and ideological practice which dealt with the reproduction of world order and the social process of production" (1982:438).

Lewis-Williams' (1980; 1981; 1982) interpretation depends on two verbatim ethnographic documents of the nineteenth century which were recorded by different people (Orpen and Bleek/Lloyd) at different places (hence with the informants interviewed at different areas). The informants had different backgrounds; and while one (Qing) actually guided Orpen (the interviewer) to some of the painting sites, the other (Dia!kwain) was only shown copies of the rock art (Lewis Williams 1980; 1982).

Lewis Williams (1980) contends that the information given by these informants was supposed to have been contradictory because they were expressed in certain unfamiliar but key metaphors. In order to unravel the meaning of rock art in South Africa, we are told to closely scrutinize metaphors such as "spoilt people," "death," and "living underwater," metaphors that are embedded in the southern San's (/Xam) apparent recognition of analogy between a "dying" medicine man and a dying eland. Both of them trembled, sweated, staggered, and were charged with power (Lewis Williams 1982). Consequently "dying" is considered to be "a metaphor for entrance into the altered

state of consciousness of trance," and "underwater" is suggested to be "analogous to the experience of trance: the struggle, gasping for breath, sounds in the ears, a sense of weightlessness, inhibited movement, affected vision and final loss of consciousness" (1980:472), while "spoilt" is a metaphor used to "describe a man in deep trance" (1982:34). Indeed Lewis-Williams maintains most of the paintings depict visions encountered during trance. As a result, he argues, the painters could probably have been people who practiced trance dance and experienced visions, or artists to whom these experiences were recounted (1980:479; 1982:434). Thus the paintings are components of the "shifting pattern of [Southern San] thought which moves from believing to seeing, and [from] the conceptual to the visual". In other words the paintings render visible a complex set of beliefs which "enabled southern San to see what they believed they could see" (1981:131).

While Lewis-Williams' views did not escape criticism (see comments on him in Current Anthropology 1982:438-446), his ideas have influenced others, and some (e.g., Smith 1993) have applied them even to areas where direct relationship between the art and the people is not clearly established, in this case the Fulani of West Africa.

This chapter is not meant to describe and discuss South African rock art. The previous brief review is, thus, meant to show that there are some successful interpretations of rock art, although, it must at the same time be noted that there are dangers of interpreting rock art of elsewhere based upon the findings from South Africa.

Unfortunately, this is not the case in Horn. Rock art research, since its beginning with Breuil in the 1930's, has been dominated with a preoccupation on description, stylistic distribution and chronological framework. Investigations were limited to description and the provision of tentative dates to the rock art. Investigators were also preoccupied with finding stylistic similarities elsewhere: Arabia, the Sahara, North Africa, and even Europe! Stylistic similarities were grouped together and used to reconstruct culture history, with the assumption that the rock art styles "degenerated" (read changed) from the earliest naturalistic to the latest schematic. Such preoccupations naturally precluded any attempt at deriving any behavioral significance.

The only "meaning" derived from the rock art in the Horn is by employing ecological, interaction and response to stress models and looking into the ecological and demographic context of the rock art (Brandt and Carder

1987; Carder 1988) to already established rock art styles and tentative dates from which inferences were made about the presence and movements of pastoralists. Accordingly, the environmental fluctuations of the mid-Holocene in the Sahara are postulated to have caused pastoral movements to the Horn, who were later to establish bipolar transhumance from the highlands to the lowlands and vice versa in search of pastures. Through time these pastoralists came in direct interaction and competition with farming communities in the highlands. This is hypothesized to have resulted in risk minimizing strategies including critical inter-regional information exchange systems and instituting rituals. Rock art might have played an important role in these rituals. As there are several rock art styles in the Horn, their close association with environmental fluctuations (that occurred at different times) and with rituals of response to stress is noted.

The rock art of the Horn is believed to be largely pastoral and there are no direct relationships between rock art and specific peoples. So far, more than a hundred rock art sites are known in the Horn. In light of the recent discoveries of new rock art sites, the region has also demonstrated its potential and no doubt many more sites are awaiting further investigation. However, because few

Neolithic sites have been excavated we know very little about the socio-economic context of the producers of the art. Future research should therefore focus on regional investigation of rock art sites, their differences and interrelationships, as well as their correlation with the general ecological and cultural remains. Therefore, the recent re-evaluation of the relationship between the rock art of the Horn and Arabia proposing the art as the work of Semitic peoples (Brandt and Agazi 2001) makes a new radical beginning towards the interpretation of the rock art.

Fig. 6.1 Engravings from Dabo Zellelew

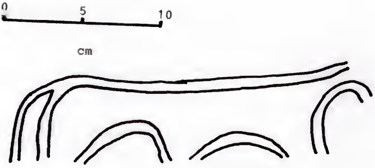


Fig. 6.2 An Engraving of a Humpless Cattle from Mihdar Abu'r

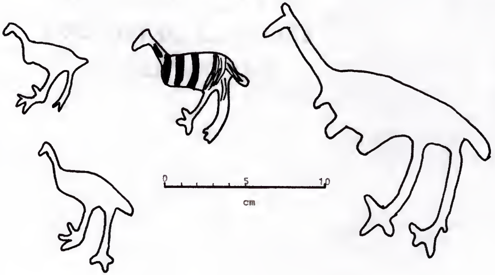


Fig. 6.3 Paintings from Tselim Ba'ati

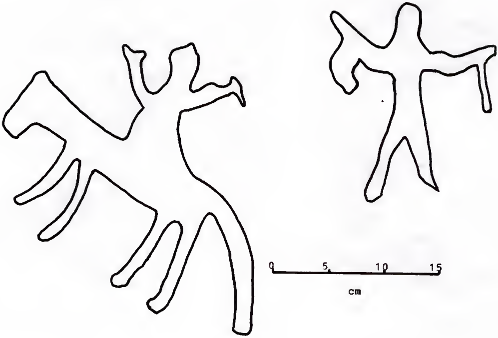


Fig. 6.4 Paintings from Tselim Ba'ati

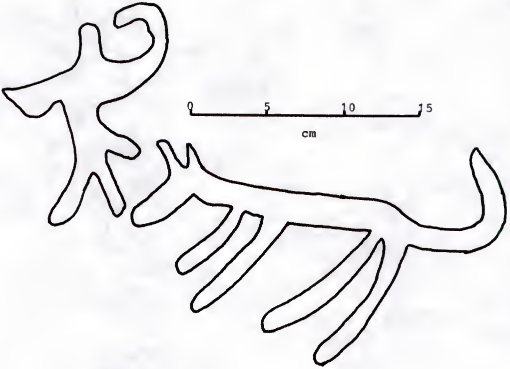


Fig. 6.5 Paintings from Tselim Ba'ati

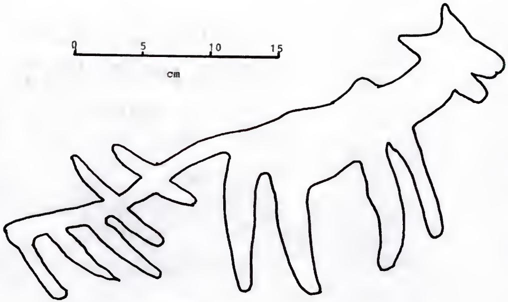


Fig. 6.6 Paintings from Tselim Ba'ati

CHAPTER 7
TOWARD A CULTURE HISTORIC SEQUENCE OF TEMBEN

Although surface scatters of lithic artifacts in the Temben area indicate artifacts belonging to MSA and LSA technology, these were not unearthed from the excavations. Direct radiocarbon dates from the excavated Temben sites, and dates derived from affinities of the lithic and ceramic artifacts from the excavated sites of the Temben region, together indicate that the area was occupied since at least the Mid-Holocene. Detailed intra-site lithic, ceramic, and in a few cases faunal assemblages and rock art discussed in the preceding chapters (chapters 3 to 6), have provided a diachronic perspective of the occupation of the Temben sites, that can conveniently, albeit tentatively, be divided into three major periods:

-Period I (pre-pottery Neolithic?) ≥ 5000 BP (?) (Ba'ati Ataro CSU-III (?); Dabo Zellelew Levels 5-7[?])

-Period II: (Neolithic with pottery) ca. 5000 - 2500 BP (Danei Kawlos Layer 5 and 4; Dabo Zellelew levels 4 to 1(?); and possibly, the earliest style of rock art)

-Period III: (Post Neolithic ?) ca 2500-? (Ba'ati Ataro CSU-I and II, Layers 3-1 of Danei Kawlos, and possibly, the later styles of rock art).

The lithic artifacts recovered from the excavated sites are too few in number to allow inter-site typological and technological comparisons. Therefore, it has not been possible to assign them into a discrete archaeological industries. The same is true for the ceramic artifacts. Decorated sherds are almost exclusively absent in all sites but Danei Kawlos. Changes in manufacturing techniques and decoration of ceramics are excellent sources for chronological construction. In fact, some scholars (e.g., Sinapoli 1991:v) maintain that ceramics offer archaeologists the "most abundant and potentially enlightening source of information on the past" unmatched by "any other category of evidence." Be that as it may, in the African context, decorative techniques and implements (Caneva 1987, 1988; Robertson 1991; Winchell 1992) and decoration motifs (e.g., Bower et al. 1977; Wandibba 1980) have been used to classify ceramics into "developmental" chronologies.

Unfortunately, such an undertaking requires a number of sites excavated and a concomitant sizable regional ceramic database. Currently the Temben region of northern Ethiopia lacks such an archaeological database. The resultant chronological division into "Periods" therefore,

encompasses a large time span. However, even so, these periods should make a foundation for further investigation as culture chronology is the starting point of any archaeological research irrespective of the theoretical perspectives (normative, processual, or post-processual) of the archaeologist. Nevertheless, these terms would be replaced by more definitive culture-stratigraphic terms as further investigation is undertaken in the area.

Period I (Pre-Pottery Neolithic?)

The evidence for this period is restricted to only ca 20 cm deposits of CSU-III of Ba'ati Ataro and possibly the lower levels (levels 5 and 6) of Dabo Zellelew. Unfortunately, however, the lithic artifacts of this period do not contain any shaped tools except for the double side and end scraper from CSU-III. The artifacts are predominantly flakes with only one blade core in the assemblage, and virtually no unmodified waste. The raw material is dominated by chert and chalcedony. The absence of shaped tools at this period is most probably the result of the scarcity of excavated sites that reach to those levels. As a result, it is difficult to compare this period of Temben prehistory to similar phases in other parts of northeast Africa. Future research on the many unexcavated

caves in the region may furnish more evidence to better describe the cultural and economic aspects of this period.

Little can be said about the subsistence patterns of the people of this time. It is unclear to what extent the occupants of Temben depended on domestic animals because only one domestic species (cattle) was identified in CSU-III of Ba'ati Ataro, and Dabo Zellelew did not yield any faunal remains. The earliest occupants of the Ba'ati Ataro could have been hunters/herders, or they could well have been hunters who were trading with pastoralists, or hunters who were stealing stock from pastoralists, or even cultivators who were also hunting. The available archaeological data, however, preclude any definitive explanation of their subsistence practices. Clearly, more work is needed to understand this period.

Period II (Neolithic with Pottery)

This period is better represented at the Temben sites, as is evident at Danei Kawlos in Layers 5 and 4 (Table 7.1-7.3). On the basis of lithic artifact similarities, it may also be represented by levels 4-1 of the open air site of Dabo Zellelew (Table 7.4-7.5). This period may also be represented by the Surre-Hanakiya stage of rock art

tradition that is displayed at Mihdar Ab'ur, and the early phases of rock art at Tselim Ba'ati and Dabo Zellelew.

Period II is characterized by small scrapers, small microliths (particularly crescents and curved backed pieces) and some truncations as well as rare burins and outilles escailles. The raw material is dominated by chert and obsidian with some chalcedony but most shaped tools are from obsidian. The ceramics are characterized by check- and rocker-stamped and incised pottery with herringbone, zigzag, mat, and dot motifs. The rock art that may belong to this period is that of the Surre-Hanakiya stage of the "Ethio-Arabian" rock art tradition, mainly composed of domestic humpless cattle.

The lithic assemblages of this period are similar to those of other sites in the region. Although straight backed and orthagonal truncations are absent and there is no obsidian artifact represented, crescents and curved backed pieces from Gobedra (Table 7.3) show metrical similarity with those of Danei Kawlos layers 4 and 5 (Table 7.1). The mean length (but width and thickness information is not available) and the mean angle of retouch of scrapers from Gobedra also show similarities with those of Danei Kawlos in that none of them fall into shallow category. While scrapers are found in all the strata at Gobedra,

microliths appear suddenly at stratum III, the bottom of which has been dated to 5000 BC (Phillipson 1977).

The typology and raw material of lithic artifacts from Quiha also resemble those of the earliest layers of Danei Kawlos. Both chipped stone assemblages are dominated by thin and small microliths, especially crescents and curved backed microliths. The predominant raw material at both places is obsidian. The Quiha lithic artifacts may therefore be contemporaneous with those of the Danei Kawlos belonging to this period.

As previously discussed in chapter 3, the Quiha and Danei Kawlos obsidian artifacts were acquired from two principal sources. Use of obsidian from the same source(s) may suggest contact between the Quiha and Temben sites during this time or a broader regional interaction/exchange network from which both sites may have obtained the raw material. Obsidian of Ethiopian origin has also been found in the Gash group levels of eastern Sudanese sites dating to the fifth and fourth millennium BP (Fattovich 1996). Unfortunately, the details of the trace element analysis are unpublished and could not be compared with the sources of Temben.

Compared to other east African regions (e.g. Kenya and Tanzania, [Merrick and Brown 1984]) Ethiopia has seen

little study of its obsidian artifacts and sources. Even for the Temben sites, obsidian trace element analysis has been undertaken not on geological raw material sources but on archaeological artifacts. An exception is the identification of two Ethiopian sources based on only one analysis of trace elements from each source (Cann and Renfrew 1964; Cann et al. 1970). Cann et al. (1970) suggest that at least some of the obsidian found in Egypt dating to as early as 5000 BC came from Ethiopian sources, a proposition supported by Zahrins (1989, 1990). It is difficult, however, to compare the recent results from Temben with those of Cann et al. (1970) because of reporting procedures. If future work shows the sources of Temben, Egypt, and eastern Sudan to be the same, this would suggest broad networks of inter-regional exchange.

The ceramic artifacts of this period also reveal similarities to other sites in the region. Many of the decorated sherds in Temben have striking similarities to those of the Atbai Ceramic Tradition of Eastern Sudan (Fattovich pers com) indicating some form of interaction between the highlands of Temben and the lowlands of Agordat (Arkell 1954) and eastern Sudan (Fattovich et al 1984; Sadr 1991).

Contact between the northern Ethiopian highlands and the lowlands of eastern Sudan has long been suggested. In the mid 1950's Arkell (1954) recognized that there were similarities in the cultural materials of both places on the basis of the ceramic surface collections from Aqordat, in the Bereka valley of Eritrea. Later investigators (e.g., Clark 1980, 1988; Sadr 1991) also recognized such similarities. Archaeological investigation in the Gash delta of eastern Sudan led Fattovich to combine the four Aqordat sites with two Eastern Sudan sites along the Gash delta (the sites of ES3 and M2) to form the "Agordat group" (Fattovich 1989). This group, on the basis of eastern Sudanese sites is securely dated to 2500-1500 BC. On the basis of ceramic similarities to this group layers 5 and 4 of Danei Kawlos probably also date to this time.

Based upon previous interpretation of the age of the rock art the naturalistic or semi-naturalistic depictions in Temben, mainly composed of domestic humpless cattle as is displayed at Dabo Zellelew, Mihdar Ab'ur, and Tselim Ba'ati, probably belong to this period as well. This style of rock art resembles other panels found in the Horn of Africa postulated to date to the mid-Holocene. Its similarity to the Juba style of rock art in Arabia (Zahrins 1982) compelled Cervicek (1979) to combine them under the

label "Ethio-Arabian style". This indicates the presence of food producing peoples in the region who were also probably in contact with Arabia. Unfortunately, reliable dates, and despite recent efforts at compiling the rock art (Agazi 1992; Carder 1988), a complete inventory of the rock art is lacking.

The economy of this time period seems to have been a combination of herding and hunting, as indicated by the faunal materials recovered from layers 5 and 4 of Danei Kawlos. There is no direct evidence of domesticated crops at the Temben sites from this period. However, domestic crops, albeit Near Eastern, dating to the end of this period have been found at Lalibela and Natchebiet caves from northern Ethiopia (Dombrowski 1971). Recent research on the agricultural evolution of India has yielded African domesticates (sorghum and finger millet) dating to as early as 1800 BC (Mehra 1991; Doggett 1991). Although these Indian findings may have not necessarily been brought from northern Ethiopia, it is nevertheless interesting to note that northern Ethiopia is situated in the probable area of origin or early spread of such domesticates (Harlan 1969). Clearly, this forms one avenue for future research. Such an undertaking would be fruitful if it is combined with obsidian trace elemental analysis. It is known that there

is no obsidian source in central Asia including India (Cann et al. 1970:583, fig.105). Obsidian of Ethiopian/Eritrean origin has, however, been found in Yemen (Zahrins 1989). If obsidian of Ethiopian origin is found associated together with sorghum and finger millet in an archaeological context, this would have profound implications on the direct prehistoric contact or "trade" between Ethiopia and India and could indicate the transfer of such domesticates from Ethiopia to India, and thus provide an indirect evidence of cultivation in Ethiopia by this time.

Period III (Post Neolithic ?)

This period is characterized by a dependence on locally available raw material (basalt and quartz). It is represented by CSU-I and II at Ba'ati Ataro and layers 3-1 at Danei Kawlos. Although no radiometric determinations are available, on the basis of lithic raw material similarities and the absence of decoration on the ceramics, the sites of Emba Ahmedin and Shegalu may also belong to this period, as does the latter stages of rock art from Dabo Zellelew and Ba'ati Tselim.

The pottery at this time is almost exclusively plain at all the sites. Shaped lithic artifacts at Ba'ati Ataro are dominated by scrapers and grinding stones but

miscellaneous backed implements are also present (Table 7.6-7.9). These tools are absent at Danei Kawlos. There is also a difference in the subsistence economy between sites. While the occupants of Ba'ati Ataro depended almost solely on the exploitation of domestic stock, those of Danei Kawlos relied upon wild animal resources in addition to domestic cattle and caprines.

By this time we have secure evidence of Ethiopian domesticated crops that were found in archaeological context dating to 2500 BP at nearby sites. Teff, wheat, barley, and flax seeds have been found in an archaeological context dating at least 2500 BP in sites around Aksum (Bard and Fattovich 1997; Boardman 1999; Phillipson 1996) while impressions of teff on pottery have been unearthed from a fourth century AD context across the Red Sea in Yemen (van Beek 1969). Boardman (1999) states that such wide range of cultivated crops (that also included pulses and vegetables) is an indication of the beginning of the plow and cereal complex of the northern highlands since 500 BC. This time period saw the development of the Aksumite empire in the region.

Some Final Remarks

The similarity of ceramic artifacts from Danei Kawlos to those of the Gash group of eastern Sudan indicate that the site was occupied since at least 5000 BP, and possibly earlier. Grinding stones (unlike Ba'ati Ataro) and other heavy duty tools are absent. The site, therefore, could have been occupied by pastoralists who were also augmenting their subsistence by hunting as indicated by the presence of domestic and wild fauna from the earliest levels of the site.

Based on indirect evidence, the existence of farming has been surmised (see above). At Ba'ati Ataro farmers occupied the site abruptly, as is indicated by the presence of ceramics, grinding stones (both lower and upper) and domestic stock that appeared together at the bottom layer of CSU-II. Later, the occupants were to incorporate iron in to their culture. Regardless of the possible origins of iron smelting (Mapunda 1997) iron was present in northern Ethiopia in pre-Aksumite times since the mid to late 3rd millennium BP. The effect of this (together with agricultural practices) on the vegetation clearing must have been felt on soil erosion. However, recent attempts at reconstructing the Late Holocene environmental history of the region (Bard et al. 2000; Fattovich et al. 2000)

notwithstanding, this has not been explicitly investigated because archaeological research of this time period focuses on monumental architecture in urban Aksumite sites. Obviously, this constitutes another avenue for future research.

I have also stated that there is some evidence of the widespread use of obsidian of an Ethiopian origin. This is potentially an indication of a broad regional interaction that may have spanned as far as Egypt (Cann and Renfrew 1964; Cann et al 1970) and Yemen (Zahrins 1989). In fact, such possibilities have compelled recent investigators in the Arabian peninsula to state that "South West Arabia should be examined in conjunction with the Horn of Africa, rather than making tenuous connections with Syria-Palestine (or Mesopotamia) alone" (Edens and Wilkinson 1998:108). Such interaction is also reflected in the similarities of the ceramic artifacts with those of Agordat and eastern Sudanese sites. This coincides with the mid-Holocene period of aridity. Given the climatic situation of this time, movement of people between the highlands of Temben and the lowlands of eastern Sudan can be hypothesized.

This broad network of interaction, however, may have changed over time (during Period II). The ceramics become site specific and there is a dependence on locally

available basalt and quartz lithic raw materials. This suggests decreasing spheres of regional interaction and decreasing mobility perhaps as a result of intensive use of land at a time coinciding with the appearance of large residential settlements that were the basis for pre-Aksumite states and the Aksumite empire (Fattovich 1999). This change also roughly coincides with the advent of the ameliorating conditions of the late Holocene.

It is significant to note the continuation of hunting by pastoralists even after cultivators who were reliant on domestic stock have already occupied the area (by CSU-I and II times at Ba'ati Ataro). The possible co-existence and interaction of these two cultural groups with different subsistence strategies should be explored further.

Unfortunately, such interaction has not been dealt with in the archaeology of the Horn. Future work should attempt to derive the intensity and spatial distribution of the interaction spheres. The ethnographic literature is replete with examples of interaction and has long been available for archaeologists to derive inference from. Thus, forest dwellers such as the Okiek (Blackburn 1982), the Aka (Bahuchet and Guillaume 1982), the Hill Pandaram (Morris 1977), and the Mbuti (Hart and Hart 1986 as cited in Gregg 1988), and pastoralists such as the Maasai

(Barfield 1993; Bernstein 1976; Spear 1993) provide their neighbors with protein in return for carbohydrates, though the degree of their interaction might differ. For instance, the relationship of the Bantu and Mbuti is asymmetrical; whereas interaction is critical to the existence of the latter to occupy the forest, the Bantu could survive without the Mbuti. The Mbuti entirely depend on the Bantu agriculturalists for carbohydrates in return for protein, which the Bantu could have obtained by hunting or from their domestic animals. However, whatever the case may be, subsistence specialization and inter-cultural exchange provide an efficient and sustainable ecological adaptation.

Such an undertaking is important not only for the understanding of contemporary relationships between populations but for prehistoric peoples as well, as interaction may have "affected the course of prehistory" (Peterson 1978:335). In fact, it can be seen from the recent proliferation of literature dealing with African archaeology. This can be witnessed by the well known case of the Kalahari San. Using archaeological, historical, and linguistic data, Denbow (1984), Denbow and Wilmsen (1986), Healand and Reid (1989), and Vierich (1982) argue that interaction between the San and their neighbors began at least as early as 500 AD. Other more recent works have

examined Neolithic interaction in northeast Africa (Sadr 1991), East Africa (Karenga-Munene 1996), and in the Iron Age of South Africa (Wadley 1996).

As I have shown in Chapter 2 such studies are lacking in northern Ethiopia. This is a result of the virtual absence of archaeological investigations and the difficulty of identifying hunter/pastoral/farmer interaction archaeologically. However, since pastoralists and agriculturalists have different kinds of adaptations this should be visible in regional settlement patterns (Gregg 1988; Sadr 1991). Information can be gleaned from sites' contents such as faunal and/or seed remains and other artifacts that would indicate seasonality and/or permanent settlement. Evidence for interaction between pastoralists and farmers should be manifested in the distribution, location and size of sites and satellite localities (Gregg 1988; Robertshaw and Collet 1983; Sadr 1991) as well as in similar dates and material remains. Interaction could be inferred from the temper, style, shape, decoration, and clay sources of ceramics (Fattovich 1990; Sadr 1991). Obsidian artifacts provide clues to exchange networks (Cann and Renfrew 1964; Cann et al. 1970; Merrick and Brown 1984). In addition, differences and similarities in rock art can be used to infer exchange of information and may

show whether there was pastoral/farmer interaction (Brandt and Carder 1987).

Recent applications of stable isotopes have proved useful in identifying interaction based on diet of prehistoric inhabitants. Using stable carbon and nitrogen data, Spielmann et al. (1990) have successfully reconstructed dietary changes among the Pecos that resulted due to their interaction with non-Puebloan peoples. In Africa stable carbon and nitrogen isotopes were instrumental in reconstructing hunter-gatherer diets and testing mobility hypothesis (Sealy 1986; Sealy and van der Merwe 1987) as well as in differentiating pastoralism from agriculture (Ambrose 1986; Ambrose and DeNiro 1986). Similar results of stable isotope analysis of human bone collagen recovered from excavation would indicate similar diet as a result of exchange of foodstuffs as pure pastoral and pure farmer diets have different isotopic values (Ambrose 1986; Ambrose and DeNiro 1986). The isotopic composition of bone collagen of these populations is consistent with the diets inferred from historical, ethnographic, and archaeological sources. Pastoralists who depend on milk, blood, and meat have higher d15N values while those who heavily rely on plants have lower values. Furthermore, populations who utilize C4 plants and grazing

herbivores have higher d13C values than those who rely on C4/C3 plants and browsers. Therefore a combined use of carbon and nitrogen ratios helps differentiate farmers from pastoralists (Ambrose and DeNiro 1989), although it must be admitted that the complexity of tropical environments makes it difficult to get clear cut resolutions (Norr 1995).

One should also recognize difficulties associated with the identification of interaction in archaeology. For instance, identification would be very difficult if segments of the same population pursue different subsistence strategies. In addition if agropastoral communities live in dispersed and short-lived homesteads the remains of those could mistakenly be identified as only pastoral sites. Therefore an examination of regional site distribution and settlement pattern is important in order to distinguish pastoral sites from others (Gregg 1988; Sadr 1991).

Conclusion

The evolution of food production remains an important issue in archaeology. In addition to the domestication of plants and animals, it also heralds the development of complex social and economic organizations as well as new interactions with the environment. Several theories have

been proposed to explain this transition to food production, including such classic ones as the oasis hypothesis (Childe 1952); the cultural readiness hypothesis (Braidwood 1960); the population growth hypothesis (Boserup 1965; Cohen 1977), and the edge or marginal land hypothesis (Binford 1968).

Such hypotheses were mainly developed to understand the origins of agriculture in the Near East. Although much is now known about early farming in Southeast Asia, Europe, and the New World (e.g. Cowan and Watson 1992; Gebauer and Price 1992; Price and Gebauer 1995), there is a paucity of archaeological data about sub-Saharan Africa. As a result, even very recent treatises that consider the shift to agriculture from a global perspective either do not talk about Africa at all (e.g., Price and Gebauer 1995) or have only a single entry (e.g., Gebauer and Price 1992). Harris and Hillman's (1989) volume stands as an exception by devoting three chapters out of forty five entries! This lack of representation of African food production may be a result of many factors, but the limited amount of archaeological research in the continent is certainly one of them (Bower 1995). Although there are many indigenous African plant domesticates, archaeological evidence for domestication remains largely unknown (Harlan 1992).

The Temben sites provide a glimpse of such an excursion in northern Ethiopia. However, much work needs to be done in order to fully understand the Neolithic economy, socio-political and ideological organization, as well as spatial settlement patterns. Needless to say, a thoroughly dated archaeological sequence tied to a comprehensive analyses of regional paleoecological evidence is required to fully understand the Holocene archaeology of the region. This will entail a multidisciplinary archaeological investigation designed at elucidating the process of domestication and subsistence change, as well as settlement pattern, combined with detailed inter-site lithic and ceramic sequences from securely dated lithostratigraphic sequences that are then tied to the paleoenvironmental record.

In this dissertation the main objective has been the reconstruction of culture chronology. However, this preliminary culture historical reconstruction remains necessarily tentative as the number of excavated sites to date are few. Furthermore, these are small-scale test excavations which are reflected in the consequent amount of artifacts recovered from these sites. In addition, there are as yet few radiocarbon determinations available which have limited the division of the time period represented in

the Temben sites. Clearly these periods are general and would be refined as further archaeological investigations in the area are forthcoming and more radiometric dates become available. However, they do provide a general working outline of the development of the Neolithic in the Temben area of northern Ethiopia, upon which future research can be based.

Table 7.1 Microlith Dimensions from Layers 4 and 5 of Danei Kawlos (ob=obsidian; che=chert; cha=chalcedony)

Microlith Type	n	Length (mm)				Width (mm)				Thickness (mm)				Raw Material		
		min.	max.	mean	sd	min	max.	mean	sd	min.	max.	mean	sd	ob	che	cha
cresent	9	14	22	17	3	5	9	6	2	1	3	2	1	4	4	1
curved backed	10	14	28	20	5	5	13	9	3	2	8	3	2	7		3
straight backed	4	12	19	16	3	3	7	6	2	1	2	2	1	4		
miscellan-eous backed	8	11	20	15	3	6	23	11	5	2	5	4	1	6	2	
orthagonal trunc-tation	2	13	14	14	1	13	14	14	1	2	3	3	1	1	1	
oblique truncation	2	15	23	19	6	7	14	11	5	2	3	3	1		2	
double backed	1		21				10				3			1		
TOTAL	36													23	9	3

Table 7.2 Scraper Dimensions from Layers 4 and 5 of Danei Kawlos (ob=obsidian; ch=chert; cha=chalcedony qu=quartz)

Scraper Type	n	Length (mm)				Width (mm)				Thickness (mm)				Raw Material		
		min	max.	mean	sd	min.	max.	mean	sd	min.	max.	mean	sd	ob	ch	qu
single end scraper	3	27	50	37	12	11	36	24	13	5	18	10	7	1	2	
single side scraper	2	27	60	44	23	33	38	36	4	5	11	8	4		2	
single end and side scraper	1		17				24				4			1		
double side and end scraper	4	21	39	29	8	15	42	30	11	5	22	11	8	1	2	1
triangular scraper	1		42				41				25				1	
circular scraper	1		45				45				16				1	
notches	5	28	41	33	7	15	39	23	14	3	12	7	5	2	3	
undifferentiated scraper	2	27	40	34	9	25	39	32	10	9	13	11	3		2	
Total scrapers	19													5	13	1

Table 7.3 Dimensions of Microliths and Scrapers from Gobedra (based on data from Phillipson, 1977)

Tool Type	n	Stratum	Length (mm)		Retouch Angle	
			Range	Mean	Range	Mean
crescent	87	I, IIa,IIb, III	12-50	18.5		
curved backed	2	IIa	17-18	17.5		
trapezoidal microlith	2	IIa	15-17	16		
triangular microlith	9	IIa, IIb	12-26	17.6		
side scraper	11	I, IIa, IIb	21-78	39	45-70	60
end scraper	18	I, II, III	15-61	30	50-80	65
irregular scraper	26	I, IIa, IIb, III, IV, V, VI	17-63	35	45-75	60
thumb nail	5	I, IIa, IV	16-23	19	30-80	60
gudit scrapers	2	I	22-27	25	70	

Table 7.4 Dimensions of Scrapers from Dabo Zellelew (qu=quartz; che=chert; cha=chalcedony)

Scraper Type	n	Length (mm)				Width (mm)				Thickness (mm)				Raw Material		
		min.	max.	mean	sd	min.	max.	mean	sd	min.	max.	mean	sd	qu	che	cha
single side scraper	2	18	28	23	7	10	30	20	14	4	16	10	8	1		1
single end and side scraper	1		19				24				5			1		
double side and end scraper	1		17				15				3				1	
semi/c-ircular scraper	1		54				34				8			1		
notches	2	17	31	24	10	34	34	34		5	9	7	3		1	1
core scraper	1		27				21				12				1	
TOTAL	8													3	3	2

Table 7.5 Dimensions of Microliths from Dabo Zellelew (qu=quartz; che=chert)

Microlith Type	n	Length (mm)				Width (mm)				Thickness (mm)				Raw Material	
		min.	max.	mean	sd	min.	max.	mean	sd	min.	max.	mean	sd	qu	che
crescent	2	22	27	25	4	7	9	8	1	2	5	4	2		2
curved backed	2	17	20	19	2	10	12	11	1	3	8	6	4	2	
orthagonal truncation	1		20				17				4				1
TOTAL	5													2	3

Table 7.6 Dimensions of Scrapers from CSU-I and II of Ba'ati Ataro (ba=basalt; qu=quartz; ch=chert)

Scraper Type	n	Length (mm)				Width (mm)				Thickness (mm)				Raw Material		
		min.	max.	mean	sd	min.	max.	mean	sd	min.	max.	mean	sd.	ba	qu	ch
single end scraper	4	14	32	24	8	18	34	24	8	6	14	11	4	1	1	2
single side scraper	3	26	37	30	6	20	35	29	8	8	13	11	3	2		1
double side scraper	1		28				29				12					1
end and side scraper	2	23	28	26	4	39	42	41	2	12	14	13	1	2		
double side and end scraper	3	24	47	35	12	15	46	31	16	5	21	12	8		1	2
circular scraper	3	43	64	50	12	42	58	47	9	25	36	29	6	1	2	
notches	6	19	53	35	15	18	42	28	11	8	29	15	10	5	1	
light duty core scraper	4	21	49	36	12	26	33	31	3	8	31	21	10		1	3
undifferentiated scraper	1		30				20				11					1
triangular steep scraper	1		45				63				27				1	
Total	28													11	7	10

Table 7.7 Dimensions of Backed Implements from CSU-I and II of Ba'ati Ataro (ba=basalt qu=quartz)

Backed Pieces	n	Length (mm)				Width (mm)				Thickness (mm)				Raw Material	
		min	max.	mean	sd	min.	max.	mean	sd	min.	max.	mean	sd	ba	qu
curved backed	2	16	24	20	6	8	13	11	4	4	6	5	1		2
misc. backed	3	15	40	24	14	12	47	27	18	3	18	9	8	2	1
orth. trunc.	3	19	27	22	5	19	35	26	8	6	10	8	2	2	1
obli. trunc.	3	21	30	25	5	17	18	18	1	6	11	9	3	1	2
double backed	1		17				11				4			1	
Total	12													6	6

Table 7.8 Dimensions of Heavy Duty Tools (note that many of the grinding stones were found broken and the minimum and/or maximum dimension does not necessarily indicate the original dimension; ba=basalt; qu=quartz; sa=sandstone)

Tool type	n	Length (mm)				Width (mm)				Thickness (mm)				Raw Material		
		min.	max.	mean	sd	min.	max.	mean	sd.	min.	max.	mean	sd	ba	qu	sa
heavy duty scraper	1		104				64				7				1	
heavy duty chopper	1		102				86				68				1	
grinding stone	34	40	400	105	70	37	270	80	45	24	92	44	15	25		9
TOTAL	36													25	2	9

Table 7.9 Dimensions of Cores from CSU-I and II of Ba'ati Ataro (ba=basalt; qu=quartz; ch=chert)

Core Type	n	Length (mm)				Width (mm)				Thickness (mm)				Raw Material		
		min.	max.	mean	sd	min.	max.	mean	sd	min.	max.	mean	sd	ba	qu	ch
amorphous core	4	32	53	41	9	24	35	31	5	22	29	24	3		4	
single platform core	20	10	48	30	12	13	57	26	10	10	40	21	8	3	9	8
double opposed core	2	65	73	69	6	57	60	59	2	31	35	33	3	2		
double adjacent core	2	39	43	41	3	36	47	42	8	18	25	22	5		1	1
multiple platform core	2	22	32	27	7	18	24	21	4	4	12	8	6		2	
bipolar core	1		22				21				13			1		
TOTAL	31													6	16	9

APPENDIX A
TRACE ELEMENT ANALYSIS

BY
Dr. Francis Brown

Samples were analyzed on a Cameca SX-50 electron microprobe equipped with four wavelength-dispersive spectrometers. The accelerating voltage was 15 kV, the beam current 25 nA, and the beam diameter between 5 and 25 μm. Concentrations were calculated from realtive peak intensities using the $\mu(pz)$ algorithm of Pouchou and Pinchoir (1991). The standard for O, Si, Al, and K was natural obsidian. The remaining elements were standardized using minerals and synthetic oxides. In order to assure an equivalent thickness of the C coating, the obsidian standard and unknowns were coated simultaneously. Details of the analytical method are provided in Nash (1992).

The attached pages are arranged as follows:
1. A list of average analyses sirted by type,
2. A list of average analyses sorted by number,
3. The original analyses from which the averages are derived.

Table 1. Averages sorted by type and ascending iron content

	SiO2	TiO2	ZrO2	Al2O3	Fe2O3	MnO	MgO	CaO	BaO	Na2O	K2O	F	Cl	Sum	less O	Total	MP H2O	Total
23-5-8	73.85	0.17	0.05	13.73	2.02	0.05	0.10	0.85	0.08	4.35	4.85	0.18	0.22	100.50	0.13	100.37	0.48	100.85
23-3-15	73.26	0.17	0.10	13.56	2.12	0.05	0.10	0.93	0.09	4.62	4.75	0.18	0.23	100.16	0.13	100.03	0.62	100.65
23-3-10	73.05	0.18	0.03	13.57	2.31	0.06	0.13	0.90	0.04	4.54	4.69	0.20	0.24	99.95	0.14	99.81	0.57	100.38
37-4-09	73.30	0.14	0.14	11.21	2.24	0.05	0.05	0.27	0.00	0.36	10.93	0.11	0.14	98.93	0.08	98.86	1.46	100.32
23-4-17	73.38	0.13	0.09	11.46	2.26	0.06	0.05	0.21	0.00	4.65	4.69	0.17	0.15	97.32	0.11	97.22	1.48	98.70
23-4-12	74.62	0.12	0.15	11.47	2.28	0.06	0.04	0.21	0.00	4.59	4.63	0.20	0.15	98.53	0.12	98.41	0.59	99.00
23-4-18	74.67	0.14	0.13	11.54	2.29	0.07	0.03	0.20	0.00	4.45	4.73	0.18	0.15	98.57	0.11	98.46	1.48	99.93
8–5–2	75.27	0.14	0.08	11.60	2.29	0.02	0.02	0.25	0.00	4.66	4.74	0.18	0.14	99.40	0.11	99.29	0.72	100.02
23-3-18	76.84	0.14	0.14	11.72	2.31	0.06	0.04	0.26	0.02	4.64	4.78	0.18	0.15	101.27	0.11	101.16	0.20	101.36
23-3-17	75.85	0.11	0.10	11.58	2.31	0.03	0.04	0.22	0.00	4.56	4.70	0.21	0.13	99.85	0.12	99.73	0.80	100.53
23-3-23	76.28	0.15	0.09	11.65	2.32	0.06	0.04	0.22	0.00	4.64	4.67	0.18	0.15	100.43	0.11	100.32	0.21	100.53
23-4-13	75.12	0.14	0.09	11.54	2.32	0.06	0.03	0.18	0.01	4.66	4.69	0.20	0.15	99.18	0.12	99.07	0.47	99.54
23-3-20	75.55	0.13	0.10	11.56	2.33	0.05	0.04	0.24	0.01	4.66	4.70	0.16	0.15	99.67	0.10	99.57	0.04	99.61
23-3-11	76.44	0.12	0.14	11.60	2.34	0.05	0.03	0.21	0.01	4.68	4.69	0.18	0.15	100.64	0.11	100.53	0.62	101.14
23-4-14	74.18	0.10	0.11	11.53	2.34	0.04	0.04	0.23	0.00	4.65	4.68	0.15	0.14	98.17	0.09	98.08	1.01	99.09
23-4-17(1)	72.88	0.15	0.06	11.43	2.35	0.07	0.05	0.22	0.00	4.59	4.72	0.18	0.14	96.84	0.11	96.73	1.78	98.51
23-4-22	73.27	0.12	0.06	11.48	2.35	0.05	0.05	0.23	0.00	4.65	4.71	0.15	0.15	97.29	0.10	97.19	1.50	98.69
37-1-14	71.15	0.17	0.13	12.22	2.84	0.12	0.01	0.57	0.07	1.66	9.72	0.24	0.32	99.23	0.17	99.06	0.94	100.00
23-3-24	72.26	0.17	0.17	10.44	3.14	0.08	0.02	0.17	0.00	0.69	10.89	0.20	0.15	98.38	0.12	98.26	0.54	98.80
23-3-16	75.90	0.20	0.10	10.87	3.33	0.06	0.02	0.18	0.00	4.95	4.66	0.28	0.17	100.73	0.16	100.58	0.57	101.15
23-3-26	75.89	0.18	0.18	10.88	3.40	0.06	0.01	0.17	0.00	4.79	4.66	0.24	0.17	100.64	0.14	100.50	0.37	100.87
23-3-27	75.71	0.18	0.15	10.91	3.41	0.05	0.01	0.20	0.00	4.86	4.62	0.23	0.17	100.52	0.14	100.38	0.26	100.64
23-3-22	75.57	0.18	0.10	10.83	3.38	0.07	0.01	0.19	0.00	4.81	4.67	0.21	0.17	100.18	0.13	100.05	-0.26	99.80
23-3-19	75.52	0.17	0.10	10.75	3.33	0.07	0.01	0.21	0.00	4.54	4.72	0.22	0.16	99.79	0.13	99.67	-0.10	99.57
23-3-28	75.45	0.16	0.09	10.78	3.31	0.08	0.01	0.20	0.00	4.76	4.66	0.22	0.17	99.89	0.13	99.76	-0.21	99.54
37-1-1	75.41	0.18	0.16	10.77	3.27	0.06	0.01	0.18	0.00	4.68	4.73	0.25	0.15	99.85	0.14	99.71	0.50	100.21
23-3-25	75.31	0.20	0.06	10.66	3.37	0.05	0.02	0.19	0.00	4.82	4.67	0.23	0.18	99.74	0.14	99.61	-0.32	99.29
23-3-14	75.20	0.20	0.12	10.78	3.25	0.07	0.02	0.20	0.00	4.72	4.64	0.26	0.15	99.61	0.14	99.47	0.45	99.92
23-4-15	74.28	0.20	0.16	10.74	3.34	0.04	0.00	0.19	0.00	4.87	4.53	0.28	0.16	98.79	0.15	98.64	0.92	99.56
23-4-10	74.11	0.19	0.17	10.71	3.27	0.05	0.01	0.19	0.00	4.69	4.65	0.19	0.17	98.41	0.12	98.29	-0.15	98.14
23-4-11	74.03	0.16	0.12	10.72	3.31	0.07	0.01	0.19	0.01	4.61	4.69	0.20	0.15	98.26	0.12	98.14	-0.02	98.12
23-4-16	73.86	0.17	0.10	10.86	3.27	0.08	0.00	0.19	0.00	4.72	4.67	0.24	0.16	98.33	0.14	98.19	0.75	98.94
23-4-20	73.58	0.16	0.09	10.78	3.31	0.05	0.02	0.20	0.00	4.77	4.71	0.22	0.17	98.05	0.13	97.92	1.50	99.41
23-4-19	73.26	0.21	0.12	10.87	3.33	0.08	0.01	0.21	0.00	4.92	4.69	0.23	0.16	98.10	0.13	97.97	1.27	99.24
23-4-17(2)	73.25	0.17	0.06	10.67	3.33	0.06	0.02	0.19	0.00	4.83	4.69	0.25	0.15	97.68	0.14	97.54	1.98	99.52

	SiO2	TiO2	ZrO2	Al2O3	Fe2O3	MnO	MgO	CaO	BaO	Na2O	K2O	F	Cl	Sum	less O	Total	MP H2O	Total
23-4-21	72.67	0.17	0.11	10.69	3.31	0.07	0.02	0.17	0.00	4.70	4.68	0.25	0.16	97.00	0.14	96.85	1.51	98.37
23-4-17(3)	71.50	0.16	0.08	10.50	3.34	0.06	0.02	0.20	0.00	4.63	4.65	0.22	0.15	95.52	0.13	95.39	2.42	97.80
23-3-21	74.79	0.17	0.15	10.70	3.33	0.08	0.01	0.19	0.00	3.47	6.57	0.22	0.16	99.83	0.13	99.70	-0.09	99.61
8–5–1	70.89	0.18	0.12	12.26	3.46	0.12	0.01	0.37	0.02	5.23	4.72	0.23	0.16	97.76	0.13	97.62	1.80	99.42
23-4-9	74.44	0.22	0.13	11.14	3.53	0.08	0.00	0.24	0.00	4.90	4.71	0.25	0.14	99.79	0.14	99.65	0.46	100.11

Table 2. Averages

Averages	SiO2	TiO2	ZrO2	Al2O3	Fe2O3	MnO	MgO	CaO	BaO	Na2O	K2O	F	Cl	Sum	less O	Total	MP H2O	Total
23-3-10	73.05	0.18	0.03	13.57	2.31	0.06	0.13	0.90	0.04	4.54	4.69	0.20	0.24	99.95	0.14	99.81	0.57	100.38
23-3-11	76.44	0.12	0.14	11.60	2.34	0.05	0.03	0.21	0.01	4.68	4.69	0.18	0.15	100.64	0.11	100.53	0.62	101.14
23-3-14	75.20	0.20	0.12	10.78	3.25	0.07	0.02	0.20	0.00	4.72	4.64	0.26	0.15	99.61	0.14	99.47	0.45	99.92
23-3-15	73.26	0.17	0.10	13.56	2.12	0.05	0.10	0.93	0.09	4.62	4.75	0.18	0.23	100.16	0.13	100.03	0.62	100.65
23-3-16	75.90	0.20	0.10	10.87	3.33	0.06	0.02	0.18	0.00	4.95	4.66	0.28	0.17	100.73	0.16	100.58	0.57	101.15
23-3-17	75.85	0.11	0.10	11.58	2.31	0.03	0.04	0.22	0.00	4.56	4.70	0.21	0.13	99.85	0.12	99.73	0.80	100.53
23-3-18	76.84	0.14	0.14	11.72	2.31	0.06	0.04	0.26	0.02	4.64	4.78	0.18	0.15	101.27	0.11	101.16	0.20	101.36
23-3-19	75.52	0.17	0.10	10.75	3.33	0.07	0.01	0.21	0.00	4.54	4.72	0.22	0.16	99.79	0.13	99.67	-0.10	99.57
23-3-20	75.55	0.13	0.10	11.56	2.33	0.05	0.04	0.24	0.01	4.66	4.70	0.16	0.15	99.67	0.10	99.57	0.04	99.61
23-3-21	74.79	0.17	0.15	10.70	3.33	0.08	0.01	0.19	0.00	3.47	6.57	0.22	0.16	99.83	0.13	99.70	-0.09	99.61
23-3-22	75.57	0.18	0.10	10.83	3.38	0.07	0.01	0.19	0.00	4.81	4.67	0.21	0.17	100.18	0.13	100.05	-0.26	99.80
23-3-23	76.28	0.15	0.09	11.65	2.32	0.06	0.04	0.22	0.00	4.64	4.67	0.18	0.15	100.43	0.11	100.32	0.21	100.53
23-3-24	72.26	0.17	0.17	10.44	3.14	0.08	0.02	0.17	0.00	0.69	10.89	0.20	0.15	98.38	0.12	98.26	0.54	98.80
23-3-25	75.31	0.20	0.06	10.66	3.37	0.05	0.02	0.19	0.00	4.82	4.67	0.23	0.18	99.74	0.14	99.61	-0.32	99.29
23-3-26	75.89	0.18	0.18	10.88	3.40	0.06	0.01	0.17	0.00	4.79	4.66	0.24	0.17	100.64	0.14	100.50	0.37	100.87
23-3-27	75.71	0.18	0.15	10.91	3.41	0.05	0.01	0.20	0.00	4.86	4.62	0.23	0.17	100.52	0.14	100.38	0.26	100.64
23-3-28	75.45	0.16	0.09	10.78	3.31	0.08	0.01	0.20	0.00	4.76	4.66	0.22	0.17	99.89	0.13	99.76	-0.21	99.54
23-4-10	74.11	0.19	0.17	10.71	3.27	0.05	0.01	0.19	0.00	4.69	4.65	0.19	0.17	98.41	0.12	98.29	-0.15	98.14
23-4-11	74.03	0.16	0.12	10.72	3.31	0.07	0.01	0.19	0.01	4.61	4.69	0.20	0.15	98.26	0.12	98.14	-0.02	98.12
23-4-12	74.62	0.12	0.15	11.47	2.28	0.06	0.04	0.21	0.00	4.59	4.63	0.20	0.15	98.53	0.12	98.41	0.59	99.00
23-4-13	75.12	0.14	0.09	11.54	2.32	0.06	0.03	0.18	0.01	4.66	4.69	0.20	0.15	99.18	0.12	99.07	0.47	99.54
23-4-14	74.18	0.10	0.11	11.53	2.34	0.04	0.04	0.23	0.00	4.65	4.68	0.15	0.14	98.17	0.09	98.08	1.01	99.09
23-4-15	74.28	0.20	0.16	10.74	3.34	0.04	0.00	0.19	0.00	4.87	4.53	0.28	0.16	98.79	0.15	98.64	0.92	99.56
23-4-16	73.86	0.17	0.10	10.86	3.27	0.08	0.00	0.19	0.00	4.72	4.67	0.24	0.16	98.33	0.14	98.19	0.75	98.94
23-4-17	73.38	0.13	0.09	11.46	2.26	0.06	0.05	0.21	0.00	4.65	4.69	0.17	0.15	97.32	0.11	97.22	1.48	98.70
23-4-17(1)	72.88	0.15	0.06	11.43	2.35	0.07	0.05	0.22	0.00	4.59	4.72	0.18	0.14	96.84	0.11	96.73	1.78	98.51
23-4-17(2)	73.25	0.17	0.06	10.67	3.33	0.06	0.02	0.19	0.00	4.83	4.69	0.25	0.15	97.68	0.14	97.54	1.98	99.52
23-4-17(3)	71.50	0.16	0.08	10.50	3.34	0.06	0.02	0.20	0.00	4.63	4.65	0.22	0.15	95.52	0.13	95.39	2.42	97.80
23-4-18	74.67	0.14	0.13	11.54	2.29	0.07	0.03	0.20	0.00	4.45	4.73	0.18	0.15	98.57	0.11	98.46	1.48	99.93
23-4-19	73.26	0.21	0.12	10.87	3.33	0.08	0.01	0.21	0.00	4.92	4.69	0.23	0.16	98.10	0.13	97.97	1.27	99.24
23-4-20	73.58	0.16	0.09	10.78	3.31	0.05	0.02	0.20	0.00	4.77	4.71	0.22	0.17	98.05	0.13	97.92	1.50	99.41
23-4-21	72.67	0.17	0.11	10.69	3.31	0.07	0.02	0.17	0.00	4.70	4.68	0.25	0.16	97.00	0.14	96.85	1.51	98.37
23-4-22	73.27	0.12	0.06	11.48	2.35	0.05	0.05	0.23	0.00	4.65	4.71	0.15	0.15	97.29	0.10	97.19	1.50	98.69
23-4-9	74.44	0.22	0.13	11.14	3.53	0.08	0.00	0.24	0.00	4.90	4.71	0.25	0.14	99.79	0.14	99.65	0.46	100.11
23-5-8	73.85	0.17	0.05	13.73	2.02	0.05	0.10	0.85	0.08	4.35	4.85	0.18	0.22	100.50	0.13	100.37	0.48	100.85
37-1-1	75.41	0.18	0.16	10.77	3.27	0.06	0.01	0.18	0.00	4.68	4.73	0.25	0.15	99.85	0.14	99.71	0.50	100.21
37-1-14	71.15	0.17	0.13	12.22	2.84	0.12	0.01	0.57	0.07	1.66	9.72	0.24	0.32	99.23	0.17	99.06	0.94	100.00
37-4-0	73.30	0.14	0.14	11.21	2.24	0.05	0.05	0.27	0.00	0.36	10.93	0.11	0.14	98.93	0.08	98.86	1.46	100.32
8–5–1	70.89	0.18	0.12	12.26	3.46	0.12	0.01	0.37	0.02	5.23	4.72	0.23	0.16	97.76	0.13	97.62	1.80	99.42
8–5–2	75.27	0.14	0.08	11.60	2.29	0.02	0.02	0.25	0.00	4.66	4.74	0.18	0.14	99.40	0.11	99.29	0.72	100.02

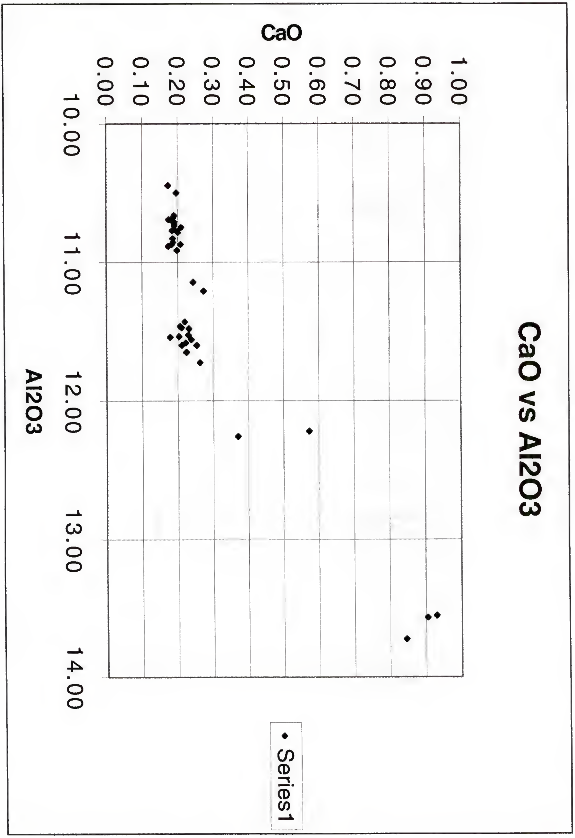
Table 3. Original Data

	SiO2	TiO2	ZrO2	Al2O3	Fe2O3	MnO	MgO	CaO	BaO	Na2O	K2O	F	Cl	Sum	less O	Total	MP H2O	Total
23-3-10	73.15	0.17	0.02	13.50	2.45	0.06	0.14	0.88	0.05	4.59	4.67	0.19	0.23	100.09	0.13	99.96	0.97	100.93
23-3-10	73.06	0.21	0.07	13.64	2.32	0.06	0.13	0.92	0.03	4.48	4.67	0.21	0.23	100.02	0.14	99.88	1.42	101.30
23-3-10	72.94	0.16	0.01	13.58	2.15	0.05	0.12	0.92	0.05	4.55	4.74	0.21	0.24	99.74	0.15	99.59	-0.68	98.91
23-3-11	76.70	0.14	0.18	11.65	2.40	0.05	0.03	0.17	0.01	4.58	4.64	0.16	0.15	100.86	0.10	100.75	0.78	101.53
23-3-11	76.30	0.08	0.08	11.55	2.31	0.06	0.03	0.26	0.01	4.78	4.68	0.20	0.15	100.50	0.12	100.38	0.72	101.11
23-3-11	76.32	0.15	0.15	11.59	2.30	0.05	0.03	0.21	0.00	4.66	4.76	0.18	0.15	100.56	0.11	100.45	0.34	100.79
23-3-14	74.89	0.13	0.17	10.76	3.27	0.08	0.03	0.18	0.00	4.65	4.60	0.24	0.16	99.17	0.14	99.03	-0.13	98.90
23-3-14	75.14	0.27	0.12	10.74	3.31	0.06	0.03	0.19	0.00	4.81	4.64	0.30	0.14	99.75	0.16	99.59	0.42	100.02
23-3-14	75.57	0.20	0.07	10.82	3.16	0.08	0.01	0.22	0.00	4.72	4.68	0.23	0.15	99.91	0.13	99.78	1.07	100.84
23-3-15	73.18	0.19	0.10	13.47	2.17	0.11	0.11	0.88	0.08	4.59	4.83	0.21	0.22	100.14	0.14	99.99	-0.08	99.91
23-3-15	73.37	0.14	0.03	13.67	2.06	0.04	0.12	0.95	0.13	4.46	4.64	0.16	0.22	100.00	0.12	99.88	0.72	100.60
23-3-15	73.23	0.19	0.16	13.53	2.14	0.00	0.09	0.95	0.07	4.82	4.76	0.17	0.23	100.35	0.12	100.22	1.22	101.44
23-3-16	75.62	0.19	0.12	10.90	3.27	0.07	0.00	0.18	0.00	4.79	4.68	0.30	0.19	100.32	0.17	100.15	0.92	101.07
23-3-16	75.79	0.19	0.05	10.99	3.33	0.06	0.03	0.19	0.00	5.06	4.69	0.31	0.16	100.84	0.16	100.68	0.78	101.46
23-3-16	76.06	0.21	0.15	10.78	3.32	0.07	0.01	0.18	0.00	4.84	4.64	0.27	0.17	100.70	0.15	100.55	0.24	100.79
23-3-16	76.12	0.21	0.08	10.82	3.41	0.05	0.02	0.19	0.00	5.11	4.64	0.24	0.18	101.07	0.14	100.93	0.34	101.27
23-3-17	75.28	0.11	0.09	11.64	2.40	0.02	0.05	0.20	0.01	4.69	4.64	0.20	0.14	99.48	0.12	99.37	1.34	100.71
23-3-17	75.90	0.10	0.09	11.48	2.24	0.04	0.02	0.22	0.00	4.43	4.72	0.22	0.12	99.59	0.12	99.47	0.29	99.76
23-3-17	76.36	0.11	0.13	11.62	2.29	0.03	0.05	0.24	0.00	4.55	4.73	0.22	0.14	100.47	0.12	100.35	0.77	101.12
23-3-18	76.96	0.12	0.11	11.77	2.33	0.04	0.01	0.22	0.00	4.58	4.77	0.19	0.14	101.25	0.11	101.14	0.36	101.50
23-3-18	76.91	0.15	0.07	11.71	2.31	0.09	0.07	0.32	0.05	4.70	4.78	0.18	0.16	101.50	0.11	101.38	-0.18	101.20
23-3-18	76.63	0.14	0.23	11.69	2.28	0.05	0.05	0.25	0.00	4.65	4.80	0.16	0.15	101.07	0.10	100.97	0.41	101.38
23-3-19	75.22	0.20	0.17	10.72	3.37	0.07	0.01	0.22	0.00	4.52	4.77	0.23	0.15	99.67	0.13	99.53	-1.30	98.24
23-3-19	75.57	0.15	0.03	10.73	3.28	0.06	0.00	0.21	0.00	4.65	4.71	0.20	0.16	99.76	0.12	99.64	0.62	100.26
23-3-19	75.76	0.16	0.09	10.79	3.34	0.07	0.03	0.20	0.00	4.45	4.69	0.22	0.15	99.96	0.13	99.83	0.39	100.22
23-3-20	75.77	0.13	0.14	11.59	2.32	0.04	0.04	0.22	0.00	4.55	4.69	0.14	0.15	99.78	0.09	99.69	-0.11	99.58
23-3-20	75.77	0.11	0.09	11.61	2.36	0.05	0.05	0.26	0.01	4.79	4.70	0.23	0.15	100.17	0.13	100.04	0.62	100.66
23-3-20	75.09	0.15	0.08	11.47	2.31	0.06	0.04	0.24	0.00	4.64	4.72	0.10	0.14	99.04	0.08	98.96	-0.38	98.58
23-3-21	74.14	0.21	0.10	10.69	3.31	0.07	0.00	0.17	0.00	2.91	7.38	0.20	0.15	99.34	0.12	99.22	0.84	100.06
23-3-21	74.56	0.14	0.18	10.73	3.40	0.07	0.01	0.17	0.00	3.93	6.28	0.28	0.15	99.89	0.15	99.74	0.48	100.23
23-3-21	75.67	0.17	0.15	10.69	3.26	0.11	0.02	0.21	0.00	3.57	6.05	0.18	0.18	100.27	0.12	100.15	-1.60	98.55
23-3-22	75.22	0.19	0.11	10.68	3.32	0.07	0.01	0.19	0.00	4.85	4.64	0.18	0.18	99.65	0.12	99.53	-1.87	97.67
23-3-22	75.54	0.18	0.12	10.85	3.26	0.07	0.01	0.19	0.00	4.78	4.69	0.23	0.15	100.07	0.13	99.94	-0.10	99.83
23-3-22	75.96	0.16	0.08	10.95	3.55	0.06	0.00	0.17	0.00	4.81	4.70	0.21	0.17	100.81	0.13	100.68	1.20	101.89

	SiO2	TiO2	ZrO2	Al2O3	Fe2O3	MnO	MgO	CaO	BaO	Na2O	K2O	F	Cl	Sum	less O	Total	MP H2O	Total
23-3-23	75.76	0.12	0.12	11.57	2.35	0.05	0.02	0.21	0.00	4.58	4.66	0.16	0.14	99.74	0.10	99.64	0.68	100.32
23-3-23	76.82	0.19	0.10	11.71	2.29	0.08	0.04	0.25	0.00	4.73	4.66	0.21	0.15	101.23	0.12	101.11	-0.60	100.50
23-3-23	76.26	0.13	0.06	11.67	2.30	0.05	0.05	0.21	0.00	4.60	4.68	0.18	0.15	100.34	0.11	100.23	0.54	100.77
23-3-24	72.63	0.22	0.12	10.51	3.19	0.07	0.02	0.18	0.01	0.82	10.69	0.24	0.16	98.85	0.14	98.72	0.94	99.66
23-3-24	71.66	0.16	0.23	10.37	3.00	0.05	0.04	0.16	0.00	0.56	10.97	0.17	0.15	97.52	0.11	97.41	0.14	97.55
23-3-24	72.50	0.13	0.14	10.45	3.24	0.10	0.00	0.18	0.00	0.70	11.01	0.19	0.13	98.76	0.11	98.65	0.55	99.20
23-3-25	75.00	0.19	0.08	10.64	3.38	0.05	0.01	0.18	0.00	4.80	4.66	0.27	0.16	99.43	0.15	99.28	-0.44	98.83
23-3-25	75.44	0.24	0.08	10.68	3.33	0.03	0.02	0.19	0.00	4.85	4.63	0.21	0.18	99.89	0.13	99.76	-0.56	99.20
23-3-25	75.48	0.17	0.03	10.66	3.38	0.06	0.02	0.19	0.00	4.80	4.74	0.21	0.18	99.91	0.13	99.79	0.06	99.84
23-3-26	75.70	0.16	0.25	10.87	3.38	0.06	0.00	0.17	0.00	4.61	4.71	0.25	0.16	100.32	0.14	100.18	0.40	100.58
23-3-26	75.72	0.21	0.18	10.84	3.34	0.05	0.02	0.17	0.00	4.98	4.65	0.27	0.17	100.59	0.15	100.44	0.37	100.81
23-3-26	76.26	0.17	0.10	10.94	3.46	0.08	0.02	0.18	0.00	4.78	4.63	0.21	0.17	101.01	0.13	100.88	0.34	101.22
23-3-27	75.57	0.15	0.12	10.94	3.49	0.04	0.00	0.19	0.00	4.89	4.65	0.26	0.18	100.49	0.15	100.34	0.62	100.96
23-3-27	75.69	0.17	0.17	10.84	3.45	0.07	0.00	0.19	0.00	4.87	4.56	0.24	0.18	100.43	0.14	100.29	0.26	100.56
23-3-27	75.88	0.23	0.16	10.96	3.29	0.06	0.02	0.21	0.00	4.83	4.65	0.18	0.16	100.63	0.11	100.51	-0.12	100.39
23-3-28	74.97	0.15	0.11	10.76	3.26	0.07	0.01	0.20	0.00	4.69	4.62	0.19	0.18	99.21	0.12	99.09	0.05	99.13
23-3-28	75.17	0.18	0.04	10.71	3.32	0.08	0.01	0.22	0.00	4.69	4.67	0.18	0.16	99.45	0.11	99.34	-0.49	98.85
23-3-28	76.20	0.16	0.11	10.88	3.34	0.08	0.01	0.18	0.01	4.89	4.69	0.28	0.18	101.00	0.16	100.84	-0.19	100.65
23-4-10	73.78	0.17	0.16	10.61	3.35	0.06	0.02	0.20	0.00	4.60	4.61	0.16	0.18	97.90	0.11	97.79	-0.69	97.10
23-4-10	73.94	0.18	0.19	10.74	3.23	0.07	0.02	0.19	0.00	4.65	4.63	0.17	0.16	98.17	0.11	98.06	0.07	98.13
23-4-10	74.62	0.21	0.18	10.77	3.23	0.04	0.00	0.18	0.00	4.81	4.73	0.22	0.17	99.15	0.13	99.02	0.17	99.19
23-4-11	73.76	0.15	0.12	10.83	3.36	0.07	0.00	0.20	0.00	4.69	4.71	0.24	0.14	98.27	0.13	98.13	-0.01	98.12
23-4-11	73.76	0.21	0.19	10.62	3.32	0.09	0.01	0.18	0.02	4.53	4.65	0.21	0.16	97.94	0.13	97.82	0.12	97.94
23-4-11	74.56	0.14	0.04	10.72	3.25	0.04	0.03	0.20	0.00	4.60	4.70	0.16	0.15	98.58	0.10	98.48	-0.18	98.30
23-4-12	74.64	0.09	0.14	11.49	2.33	0.06	0.03	0.23	0.00	4.43	4.60	0.23	0.15	98.42	0.13	98.29	0.74	99.04
23-4-12	75.08	0.16	0.21	11.59	2.23	0.09	0.04	0.20	0.00	4.67	4.63	0.18	0.15	99.23	0.11	99.12	0.29	99.41
23-4-12	74.14	0.12	0.12	11.34	2.28	0.03	0.03	0.21	0.00	4.66	4.67	0.20	0.16	97.93	0.12	97.81	0.72	98.53
23-4-13	74.69	0.12	0.18	11.52	2.30	0.07	0.03	0.20	0.01	4.65	4.64	0.19	0.15	98.76	0.11	98.64	0.92	99.56
23-4-13	74.91	0.18	0.03	11.47	2.38	0.04	0.02	0.17	0.01	4.60	4.69	0.18	0.15	98.83	0.11	98.72	0.59	99.31
23-4-13	75.76	0.13	0.07	11.63	2.27	0.06	0.05	0.16	0.00	4.74	4.73	0.22	0.14	99.96	0.13	99.84	-0.10	99.73
23-4-14	73.57	0.09	0.09	11.50	2.39	0.03	0.04	0.21	0.00	4.63	4.63	0.14	0.14	97.46	0.09	97.37	1.60	98.97
23-4-14	74.79	0.12	0.09	11.60	2.39	0.04	0.04	0.24	0.00	4.72	4.69	0.17	0.15	99.05	0.10	98.94	2.00	100.94
23-4-14	74.17	0.09	0.15	11.48	2.26	0.04	0.02	0.23	0.00	4.59	4.72	0.13	0.14	98.02	0.09	97.93	-0.57	97.36

	SiO2	TiO2	ZrO2	Al2O3	Fe2O3	MnO	MgO	CaO	BaO	Na2O	K2O	F	Cl	Sum	less O	Total	MP H2O	Total
23-4-15	73.44	0.18	0.10	10.79	3.31	0.02	0.00	0.19	0.00	4.76	4.52	0.25	0.18	97.74	0.15	97.60	1.69	99.29
23-4-15	74.49	0.21	0.19	10.75	3.32	0.05	0.01	0.20	0.00	5.05	4.52	0.31	0.14	99.24	0.16	99.08	0.80	99.87
23-4-15	74.92	0.22	0.18	10.67	3.38	0.05	0.00	0.18	0.00	4.79	4.56	0.27	0.16	99.38	0.15	99.23	0.28	99.51
23-4-16	73.04	0.20	0.00	10.72	3.29	0.06	0.00	0.19	0.00	4.76	4.65	0.24	0.16	97.31	0.14	97.17	0.58	97.75
23-4-16	74.26	0.17	0.22	10.87	3.22	0.10	0.00	0.19	0.00	4.70	4.68	0.22	0.16	98.79	0.13	98.66	0.99	99.65
23-4-16	74.29	0.15	0.07	10.98	3.30	0.10	0.00	0.18	0.00	4.71	4.70	0.26	0.15	98.88	0.14	98.74	0.68	99.43
23-4-17	73.56	0.14	0.10	11.47	2.32	0.07	0.05	0.19	0.00	4.72	4.67	0.16	0.15	97.62	0.10	97.51	0.95	98.47
23-4-17	72.73	0.11	0.11	11.43	2.24	0.06	0.04	0.18	0.00	4.62	4.69	0.15	0.17	96.52	0.10	96.42	2.40	98.83
23-4-17	73.86	0.14	0.07	11.48	2.23	0.06	0.07	0.24	0.00	4.62	4.72	0.19	0.14	97.83	0.11	97.72	1.08	98.80
23-4-17(1)	72.78	0.15	0.00	11.40	2.37	0.07	0.03	0.21	0.01	4.43	4.65	0.16	0.14	96.40	0.10	96.30	1.82	98.12
23-4-17(1)	72.72	0.14	0.06	11.38	2.34	0.08	0.06	0.24	0.00	4.66	4.72	0.18	0.14	96.73	0.11	96.62	2.09	98.71
23-4-17(1)	73.14	0.16	0.11	11.51	2.34	0.07	0.05	0.20	0.00	4.67	4.78	0.21	0.15	97.40	0.12	97.28	1.43	98.71
23-4-17(2)	72.75	0.16	0.03	10.50	3.34	0.06	0.03	0.17	0.00	4.75	4.68	0.29	0.14	96.90	0.15	96.75	2.02	98.77
23-4-17(2)	72.97	0.17	0.10	10.68	3.36	0.06	0.01	0.18	0.00	4.75	4.69	0.19	0.16	97.31	0.12	97.20	1.99	99.18
23-4-17(2)	74.05	0.17	0.07	10.84	3.31	0.06	0.02	0.21	0.00	4.98	4.68	0.27	0.16	98.83	0.15	98.68	1.94	100.62
23-4-17(3)	71.00	0.20	0.05	10.36	3.27	0.06	0.00	0.18	0.00	4.66	4.67	0.22	0.13	94.80	0.12	94.68	2.89	97.57
23-4-17(3)	71.47	0.18	0.16	10.41	3.39	0.07	0.02	0.19	0.00	4.78	4.64	0.24	0.17	95.72	0.14	95.58	2.31	97.88
23-4-17(3)	72.04	0.10	0.04	10.71	3.38	0.06	0.02	0.22	0.00	4.45	4.64	0.21	0.17	96.04	0.13	95.91	2.05	97.96
23-4-18	75.87	0.16	0.14	11.70	2.37	0.07	0.02	0.21	0.00	4.51	4.65	0.17	0.16	100.02	0.11	99.92	1.48	101.39
23-4-18	74.65	0.14	0.16	11.42	2.28	0.07	0.01	0.19	0.00	4.48	4.72	0.22	0.16	98.49	0.13	98.37	1.45	99.81
23-4-18	73.50	0.12	0.08	11.49	2.22	0.06	0.04	0.21	0.00	4.38	4.80	0.15	0.15	97.18	0.09	97.09	1.50	98.59
23-4-19	72.64	0.23	0.19	10.83	3.30	0.09	0.01	0.19	0.00	4.90	4.62	0.20	0.17	97.38	0.12	97.25	1.23	98.48
23-4-19	73.25	0.21	0.18	10.90	3.34	0.08	0.01	0.20	0.01	4.95	4.71	0.23	0.14	98.20	0.13	98.07	1.54	99.60
23-4-19	73.89	0.19	0.01	10.88	3.35	0.07	0.01	0.23	0.00	4.91	4.75	0.26	0.17	98.73	0.15	98.58	1.06	99.64
23-4-20	73.60	0.15	0.11	10.88	3.34	0.05	0.02	0.18	0.00	5.01	4.76	0.19	0.16	98.45	0.12	98.34	2.06	100.39
23-4-20	74.13	0.18	0.15	10.77	3.26	0.04	0.02	0.21	0.00	4.48	4.72	0.21	0.16	98.31	0.13	98.19	1.40	99.58
23-4-20	73.00	0.16	0.02	10.67	3.32	0.07	0.02	0.20	0.00	4.82	4.67	0.26	0.18	97.38	0.15	97.23	1.04	98.26
23-4-21	72.32	0.16	0.04	10.65	3.35	0.04	0.01	0.18	0.00	4.52	4.71	0.23	0.17	96.37	0.14	96.23	2.41	98.65
23-4-21	72.57	0.18	0.14	10.72	3.24	0.09	0.03	0.17	0.00	4.94	4.65	0.31	0.14	97.18	0.16	97.02	0.89	97.91
23-4-21	73.11	0.17	0.15	10.70	3.33	0.09	0.03	0.17	0.00	4.62	4.68	0.22	0.17	97.44	0.13	97.31	1.24	98.55
23-4-22	73.09	0.15	0.07	11.57	2.46	0.05	0.06	0.22	0.01	4.55	4.70	0.13	0.15	97.21	0.09	97.12	1.86	98.97
23-4-22	73.17	0.15	0.04	11.48	2.36	0.05	0.05	0.24	0.00	4.58	4.71	0.16	0.17	97.15	0.11	97.05	1.47	98.52
23-4-22	73.53	0.07	0.09	11.39	2.24	0.05	0.05	0.24	0.00	4.83	4.72	0.15	0.14	97.49	0.09	97.40	1.17	98.57

	SiO2	TiO2	ZrO2	Al2O3	Fe2O3	MnO	MgO	CaO	BaO	Na2O	K2O	F	Cl	Sum	less O	Total	MP H2O	Total
23-4-09	74.16	0.25	0.16	11.07	3.53	0.12	0.00	0.25	0.00	4.98	4.73	0.25	0.13	99.63	0.14	99.49	0.48	99.98
23-4-09	74.48	0.22	0.14	11.24	3.58	0.04	0.01	0.24	0.00	4.93	4.66	0.24	0.14	99.92	0.13	99.79	0.44	100.23
23-4-09	74.68	0.20	0.09	11.12	3.48	0.07	0.00	0.24	0.00	4.79	4.75	0.26	0.14	99.81	0.14	99.67	0.46	100.13
23-5-08	74.11	0.17	0.09	13.58	2.01	0.07	0.13	0.81	0.05	4.14	4.86	0.18	0.22	100.40	0.13	100.27	0.77	101.04
23-5-08	73.59	0.17	0.01	13.88	2.04	0.02	0.08	0.88	0.12	4.56	4.85	0.18	0.22	100.60	0.13	100.47	0.20	100.67
37-1-1	75.25	0.16	0.16	10.76	3.34	0.06	0.01	0.20	0.00	4.61	4.84	0.27	0.15	99.80	0.15	99.65	0.34	99.99
37-1-1	75.38	0.17	0.09	10.71	3.21	0.05	0.01	0.19	0.00	4.74	4.78	0.23	0.16	99.70	0.13	99.57	0.24	99.82
37-1-1	75.61	0.20	0.21	10.85	3.26	0.07	0.02	0.17	0.00	4.70	4.58	0.26	0.14	100.06	0.14	99.92	0.91	100.83
37-1-14	70.95	0.21	0.16	12.27	2.75	0.09	0.02	0.56	0.09	1.97	9.29	0.23	0.31	98.91	0.17	98.75	1.99	100.74
37-1-14	71.04	0.13	0.10	12.10	2.83	0.11	0.01	0.58	0.09	1.89	9.49	0.24	0.30	98.91	0.17	98.74	0.94	99.68
37-1-14	71.47	0.16	0.13	12.30	2.94	0.16	0.00	0.57	0.04	1.13	10.39	0.25	0.35	99.88	0.18	99.70	-0.13	99.57
37-4-09	73.60	0.12	0.14	11.27	2.26	0.06	0.05	0.22	0.00	0.50	10.82	0.16	0.14	99.35	0.10	99.25	0.61	99.86
37-4-09	73.31	0.16	0.15	11.27	2.14	0.02	0.05	0.18	0.00	0.39	10.87	0.06	0.15	98.75	0.06	98.69	2.42	101.11
37-4-09	72.98	0.15	0.12	11.09	2.31	0.06	0.06	0.42	0.00	0.19	11.10	0.10	0.13	98.71	0.07	98.64	1.35	99.99
8–5–1	70.80	0.17	0.12	12.22	3.43	0.12	0.02	0.37	0.00	5.36	4.72	0.22	0.16	97.70	0.13	97.57	1.63	99.20
8–5–1	69.87	0.17	0.08	12.25	3.45	0.15	0.00	0.37	0.02	5.04	4.71	0.22	0.16	96.49	0.13	96.36	2.85	99.20
8–5–1	71.99	0.19	0.16	12.31	3.50	0.10	0.00	0.37	0.02	5.28	4.74	0.25	0.16	99.08	0.14	98.94	0.91	99.86
8–5–2	75.10	0.08	0.04	11.66	2.24	0.01	0.01	0.21	0.00	4.88	4.72	0.18	0.15	99.28	0.11	99.17	0.78	99.96
8–5–2	75.51	0.19	0.08	11.63	2.36	0.01	0.03	0.32	0.00	4.76	4.74	0.16	0.14	99.92	0.10	99.83	0.44	100.27
8–5–2	75.21	0.15	0.11	11.50	2.28	0.05	0.02	0.23	0.00	4.35	4.76	0.21	0.14	99.00	0.12	98.88	0.94	99.82


CaO vs Al2O3
CaO
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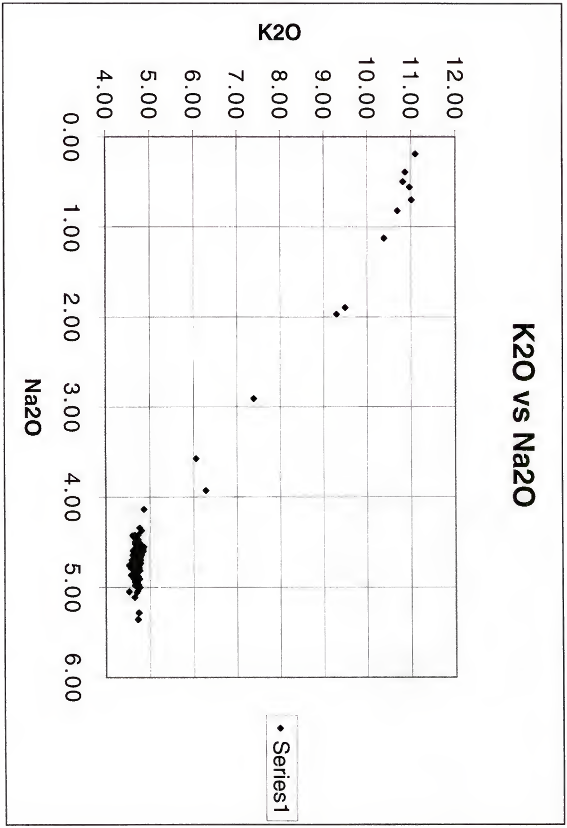
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
10.00
11.00
12.00
13.00
14.00
Al2O3
Series1


K2O vs Na2O
K2O
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8.00
7.00
6.00
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APPENDIX B
PRELIMINARY REPORT ON THE FAUNAS FROM THE SITES OF BAATI ATARO (EjJu 37) AND DANEI KAWLOS (EjJu 23)

Prepared for Mr. Agazi Negash

By

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Introduction

A total of 1633 faunal specimens were studied from three cultural stratigraphic units at Baati Ataro (EjJu 37) and 1697 faunal specimens were studied from five stratigraphic layers at Danei Kawlos (EjJu 23). Zooarchaeological research at both sites was oriented towards understanding the nature of site formation processes, and the character of subsistence activities.

There has been very little zooarchaeological research conducted on fauna from Holocene sites in the Horn of Africa. Based on faunal patterns in the Sudan and Eastern Africa and limited information on Holocene patterns of faunal use in Ethiopia from the sites of Gobedra (Phillipson 1977) in northern Ethiopia, and Lake Besaka (Brandt 1980) in the Rift Valley, I developed the following broad hypotheses for testing.

1. The earliest cultural activities at these sites would be those of hunter-gatherers focusing on a broad range of wild mammals.
2. Herding of cattle, sheep, and goat would occur in upper levels.

Methods

Following methods developed for the study of African faunas (Gifford et al. 1980; Marshall 1990a), all identifiable specimens were individually bagged, labeled, sorted, and identified. All such specimens were given zooarchaeological catalog numbers. Marginally identifiable specimens, such as rib shaft fragments, cranial, axial, or long bone shaft fragments were left bagged in groups by provenience category under one catalog number. The same procedure was followed for non-identifiable specimens.

Identification

Specimens were initially sorted by body part and subsequently by taxon. All identifications were made by reference to comparative material housed in the National Museum or, for those specimens that were not available, by reference to identification manuals such as Walker 1985, Schmid 1972. Levels of identification used vary from class, Mammalia, orders such as Artiodactyla or Carnivora, genera such as bovid or suid to more specific tribal or species level distinctions. In some cases, as is common in African zooarchaeology, size classes were also used. In general, because of lack of comparative material, identifications were cautious.

Bone Modification

We recorded the presence of cut marks, gnaw marks, burning, root action or weathering for individual specimens. Detailed study of the location of these marks was not undertaken however.

Measurement

Measurements were taken on all complete specimens and on all complete long bone ends. Measurement sites used follow von den Driesch (1976).

Quantification

All specimens were counted. Number of identifiable specimen or NISP is the unit of quantification used here. The sample sizes for any one unit were not large enough to warrant calculation of minimum numbers of individuals (MNI).

Results

Danei Kawlos (EjJu 23)

1697 faunal specimens were studied from five stratigraphic layers at Danei Kawlos (EjJu 23). Taxonomic representation is summarized in Table 1. There are changes in taxonomic representation through time.

Stratigraphic layer five

Nine hundred and thirty nine specimens were studied from this unit at the base of the cultural stratigraphic sequence, 179 or 19% of these were maximally identifiable, that is identifiable to tribe or genus. This assemblage is dominated by rodents (143/179 or 79.9%). A small number of mollusks (10/179 or 5.6%) are also present. Hyrax are also present in small but significant numbers (8/179 or 4.5%). Even smaller numbers of hare (4 or 2.2%) and wild suid (4 or 2.2%) are present. Domestic cattle (4 or 2.2%) and possibly caprines (1 or 0.5%) are represented. One specimen of human and one primate as well as one fish specimen were also found.

Stratigraphic layer four

Three hundred and forty-four specimens were studied from this unit, 49 or 14.2% of which were maximally identifiable. Just as in unit five, rodents dominate unit four (40/49 or about 81.6%). The total sample is smaller and patterns are weaker, but as in unit five, hyrax (4/49 or 8.1%) and hare (1/49 or 2.1%) are present, as are cattle (2/49 or 4%) and caprines (1/49 or 2.1%).

Stratigraphic layer three

The sample from this unit is small, one hundred and thirty-eight specimens were studied from this unit, only 14 or 10.1% of which were maximally identifiable. Just as in the lower levels, rodents dominate the identifiable material (9) and cattle (1) and caprines (1) are present. Reptiles (3) were identified in this unit. They were not present in lower units.

Stratigraphic layer two

The sample from this unit is also small, one hundred and ninety specimens, only 9 or 4.7% of which were maximally identifiable. Rodents (4) were once again the dominant taxon, a reptile was identified, and cattle (2) and caprine (1) bones are present. A hyrax (1) was identified for the first time in these levels.

Stratigraphic layer one

The sample from this unit is also small, eighty-six specimens, only 10 or 11.6% of which were maximally identifiable. Rodents (5) were the most common of the identified specimens, cattle (3) and caprine (1) bones are present, and a hyrax (1) was identified.

Baati Ataro

A total of 1633 faunal specimens were studied from three cultural stratigraphic units at Baati Ataro (EjJu 37). Species representation is summarized in Table 2.

Cultural stratigraphic unit three

The sample from this unit is small, one hundred and fifty-seven specimens were studied from this unit, only 4 or 2.5% of which were maximally identifiable. Two dik-dik, one hyrax, and one cow specimen were identified.

Cultural stratigraphic unit two

The sample from this unit is large, 1,131 specimens were studied from this unit, only 15 or 1.3% of which were maximally identifiable. Seven cattle (7/15 or 46.6%), five caprine (5/15 or 33.3%), one dik-dik, one hyrax, and one tortoise specimens were identified.

Cultural stratigraphic unit one

Three hundred and forty-five specimens were studied from this unit, only 11 or 3.1% of which were maximally identifiable. Six cattle (6/11 or 54.5%) and five caprine (5/11 or 45.5%) specimens were identified.

Discussion

Danei Kawlos

Rodents are by far the most dominant taxon in all stratigraphic layers. They make up 65% of all maximally identifiable specimens from the site. Although some of them may have been eaten (this will be addressed in the final report), many of them are likely to have been intrusive. This raises the question of their role in site formation processes. It seems likely that, at least in some places, rodents caused disturbance to the stratigraphic integrity of the site. As a result, it will be important to cross check wherever possible provenience information for stratigraphic units and to obtain direct AMS dates on organic artifacts of importance. I am aware that some of these pre-cautionary measures are already in progress.

There is little or no evidence for carnivore activity at the site. Apart from intrusive rodent specimens, the material studied was accumulated prehistorically by humans during the course of butchery, cooking, consumption, and discard of animal food at the rock shelter.

The hypothesis that domestic cattle, sheep, and goats would only appear in later levels is also not supported by the results of this analysis. Although the numbers are very small, cattle are present from the lowest

stratigraphic layers at Danei Kawlos. (The lowest well-identified specimen is from level 27, test unit 3.) Domestic stock make up 6/228 or 2.6% of the identified fauna from cultural stratigraphic levels four and five.

There is no increase in the number of specimens of domestic stock through the Danei Kawlos sequence with time, numbers of specimens remain relatively constant. But because sample sizes decrease, domestic stock forms a larger proportion (6/33 or 18%) of the identified material in upper levels.

Baati Ataro

By contrast with Danei Kawlos, rodents were rare or not identified at Baati Ataro. There is no evidence for bioturbation. There is also no evidence for carnivore activity. It is likely that all the material studied was produced by humans during the course of butchery, cooking, consumption, and discard of animal food at Baati Ataro.

The hypothesis that a wide range of mammals would have been hunted in earlier periods is not supported by the fauna from Baati Ataro. Wild mammals are more common in cultural stratigraphic units two and three than in cultural stratigraphic unit one. But these are all small, largely

dik-dik and hyrax, and there is a marked absence of large wild ungulates.

The hypothesis that domestic cattle, sheep, and goats would only appear in later levels is not supported by the results of this study. Although the numbers are very small, cattle are present from low cultural stratigraphic units at Baati Ataro. The lowest secure specimens are from level 46 (test unit one) and level 42 (test unit one) This pattern persists and strengthens in upper levels. Domestic animals make up 46% (7/15) of the identified specimens from cultural stratigraphic level two, and 54% (6/11) of the identified specimens from cultural stratigraphic unit one. In fact, cattle and caprines together make up all the identified specimens in cultural stratigraphic unit one.

Samples are small, but there is an interesting difference between the patterns of species representation in cultural stratigraphic unit three and cultural stratigraphic unit two (Fig. 1). In unit three, small mammals, dik-dik and hyrax dominate the identified specimens. Cattle are present but represented by just one specimen. In unit two, dik-dik and hyrax are still present, but domestic stock becomes more common. In unit one, small wild mammals disappear and cattle and caprines are common. When specimens identified only to size class are added to

the analysis in the final report, it will be possible to see that this pattern is quite strong (Fig 2).

Conclusion

The faunas from Danei Kawlos and Baati Ataro are important as the first sizable excavated and systematically analyzed faunal assemblages from long Holocene sequences in northern Ethiopia. The lack of hunting of large wild mammals is very interesting and differs from what is known of early and mid-Holocene patterns of use of wild fauna in the Sudan and in Kenya. Both sites rely on small wild animals, especially hyrax, but there are differences between the sites in taxa used. At Danei Kawlos the spectrum of taxa found is broader than at Ataro and hare and suid were eaten. At Ataro dik-dik were more important. These differences may relate to environment and mammalian abundance during periods of occupation. There is nothing to suggest high rainfall, and the fauna from both sites would be compatable with fairly arid conditions.

In the absence of dates, or information on paleoclimate, or settlement patterns, it is difficult to fully understand the significance of the reliance on small wild mammals at these sites. It could be that large wild mammals were scarce due to aridity. It is also possible

that use of the landscape was already quite intensive by the time that the sites were occupied and that large mammals were scarce for this reason. This line of reasoning fits with the presence of domestic stock at the sites and the increasing dependence on small mammals documented at many early food producing sites around the world.

The presence of domestic cattle from the base of the sequence at both Danei Kawlos and Baati Ataro is also intriguing. Once the dates are known, it will be possible to think systematically about the possible origin of the domestic stock at Danei Kawlos and Baati Ataro. A Sudanese origin, from the Khartoum Nile and sites like Kadero and then via the sites of the Butana phase of the southern Attbai seems probable. This hypothesis would be supported by dates for the earliest cattle or sheep and goat from these sites falling within the last 4500 years. But if the dates for the earliest domestic stock at these sites date to 5000 b.p. or older (an unlikely event), then we would have to consider a Near-Eastern origin for domestic stock in the Horn of Africa.

It is difficult to determine whether the very earliest occupants of Baati Ataro were hunter-gatherers who later adopted herding, or whether incoming herders occupied the shelter shortly after the hunter-gatherers. Nevertheless,

it is clear at both Baati Ataro and Danei Kawlos that there is change through time in the degree to which early herders relied on domestic *versus* wild resources. By the upper levels of Baati Ataro, the fauna resembles that accumulated by specialized pastoralists. Taken together, these rock shelters provide an excellent record of the beginnings and development of herding in northern Ethiopia.

Table 1. Species Representation at Kawlos.

	Cattle	Caprine	Hyrax	Hare	Suid	cf. Fish	Reptile	Porcupine	Rodents	cf. Rodent	Human	Primate	Mollusc	Unidentified	CSU Total
CSU 1	3	1	1						5					76	86
CSU 2	2	1	1				1		4					181	190
CSU 3	1	1					3		8	1				124	138
CSU 4	2	1	4	1					37	3			1	295	344
CSU 5	4	1	8	4	4	1		2	116	27	1	1	10	760	939
Total	12	5	14	5	4	1	4	2	170	31	1	1	11	1436	1697

Table 2. Species Representation at Ataro.

	Cattle	Caprine	Dik-dik	Hyrax	Tortois	Not well identif	CSU Total
CSU 1	6	5				334	345
CSU 2	7	5	1	1	1	1116	1131
CSU 3	1		2	1		153	157
Total	14	10	3	2	1	1603	1633

Figure 1. Selected Species Representation at Kawlos.

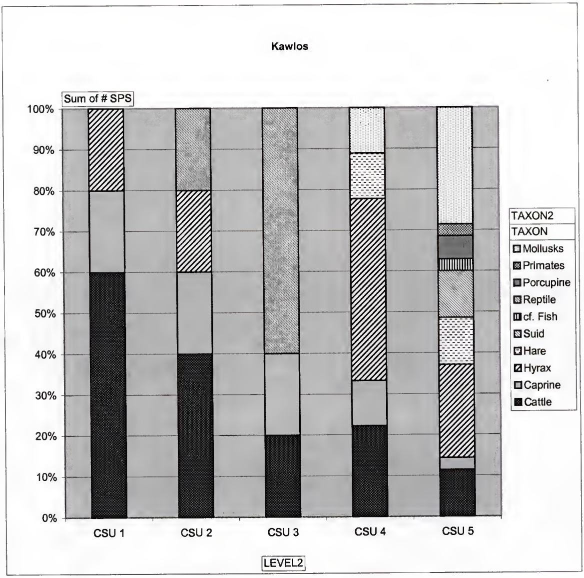


Figure 2. Size Class Representation at Kawlos.

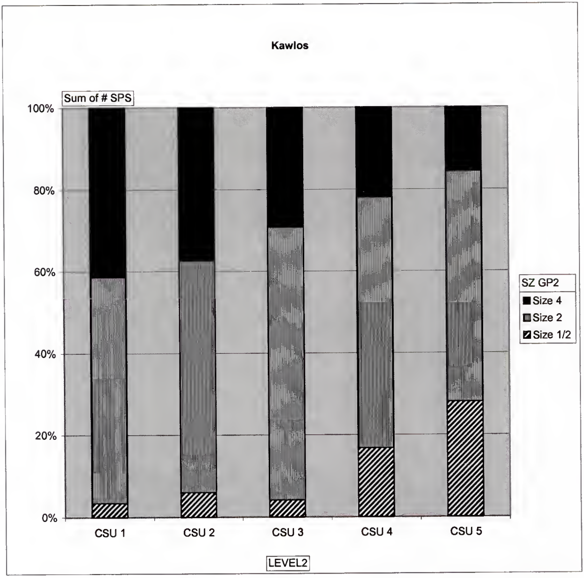


Figure 3. Selected Species Representation at Ataro.

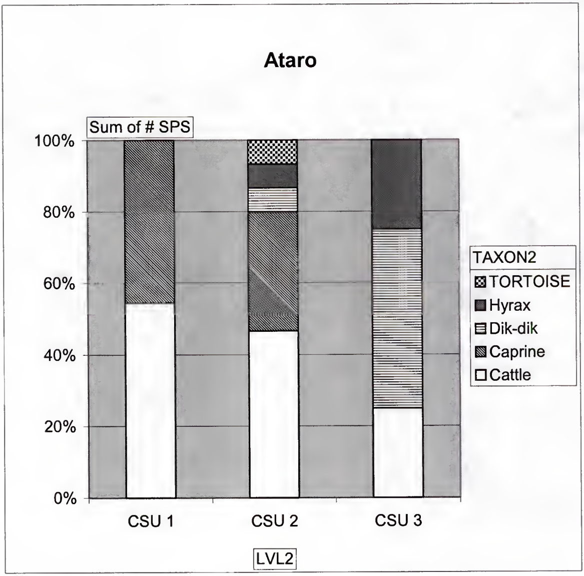
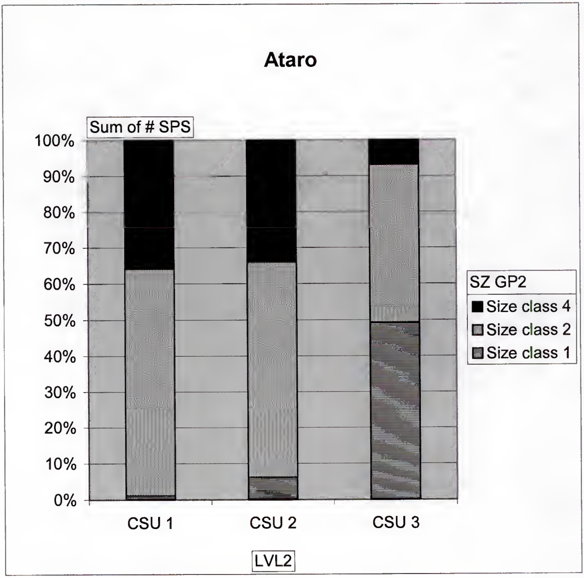


Figure 4. Size Class Representation at Ataro.



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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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This dissertation was submitted to the Graduate Faculty of the Department of Anthropology in the College of Liberal Arts and Sciences and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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